3.8 FISH AND AQUATIC HABITAT

3.8.1 Affected Environment

3.8.1.1 Stream Systems

PALCO's lands in northern California include numerous streams that flow from the coast ranges to the Pacific Ocean. Major rivers and streams include the Eel River, Mattole River, Elk River, Salmon Creek, Bear River, Van Duzen River, and Yager Creek (Figure 3.4-2). Smaller areas of PALCO ownership (about 3,586 acres) are found in the Mad River drainage (in the Iaqua Buttes and Butler Valley HUs). Humboldt Bay and the adjacent Eel River estuary are prominent features along the coastline in this area.

Figure 3.8-1 presents the stream classes that occur on lands that will be included under the proposed HCP. There are approximately 264 miles of Class I (fish-bearing), 752 miles of Class II (aquatic life but non-fish-bearing), and 576 miles of Class III (no aquatic life) streams (Table 3.8-1). The stream miles were based on GIS information from PALCO (1998) that was modified by additional information on fish distributions from CDFG (Personal communication, L. Preston, CDFG [Eureka]; Personal communication, S. Downie, CDFG [Redway, 1997]; and Institute for Fisheries Resources, 1998). The stream lengths for each of the classifications could be further revised based on availability of new information concerning distributions of fish and additional field study. This new information would be developed as part of watershed analyses and the detailed THP process for specific harvest units.

The estimate of stream miles for Class III streams is considered low as Class III streams usually require on-site inspection for identification and classification because they are difficult or impossible to identify from maps or aerial photos. For example, PALCO has recently estimated that Class III streams may exceed 3,200 miles on its lands (PALCO, 1998, Volume 1, Page 18). PALCO and Elk River Timber Company lands have not had detailed on-the-ground mapping for Class III streams.

Table 3.8-1 also identifies the miles by stream class for the proposed Headwaters Reserve. All three stream classes on these lands comprise fewer than 61 miles.

3.8.1.2 Streamside Habitat

Figures 3.8-2 a, b, and c present the linear extent of streamside vegetation and seral types that currently exists in riparian zones along Class I, II, and III streams on PALCO lands. The information is presented by number of stream miles. For example, there are currently about 1.2 miles (out of 22.6 miles total) of old-growth forest along Class I streams in the Bear River HU (Figure 3.8-2a). Vegetation and seral type classifications for these areas (adapted from PALCO, 1998) are defined in Section 3.9. In general, mid-to-late seral stages predominate along streams in most HUs, with very little old growth present on any PALCO lands except stream segments along the North Fork Mattole and in the Headwaters Forest, where it predominates. Very approximate estimates of the changes in vegetation and seral types over time for each alternative are discussed in Section 3.7.

3.8.2 Current Stream Habitat Conditions

Key physical components of the aquatic ecosystem include floodplains, streambanks, channel structure, water quality, and water quantity. Habitat complexity is created and maintained by rocks, sediment, large wood, and favorable water quantity and quality. Upland and riparian areas influence aquatic ecosystems by supplying sediment, woody debris, and water. Disturbance processes such as landslides and floods are important mechanisms for delivery of wood and bedload to streams. The following section describes the existing stream habitat conditions for the PALCO lands.

General Characteristics

Stream habitat conditions on PALCO lands are affected by a wide range of factors including geophysical changes (e.g., earthquakes and associated uplifting), extremes of flow (e.g., flooding and low flow), existing geological conditions (e.g., erodible soils), and land-use practices (e.g., timber harvest, grazing, urban development, road construction and operation, and gravel mining). The effects of these combined factors result in the existing stream habitat conditions. The following are general characterizations of existing limitations to productivity of aquatic resources in the WAAs.

- Humboldt WAA—Instream habitat limitations include shallow mean pool depth, low instream cover levels, and a high level of fine sediment (PALCO, 1998). Under Section 303(d) of the CWA, EPA listed Freshwater Creek and Elk River as "water quality limited" due to sediment problems (see Section 3.4).
- Yager WAA—Stream aquatic habitat limitations include low percent canopy instream cover levels (PALCO, 1998). Also, the Yager River is listed under Section 303(d) for sediment problems.
- Van Duzen WAA—Instream habitat limitations include low percent pools, low in stream cover levels and high levels of fine sediment (PALCO, 1998). Also, the Van Duzen River is listed under Section 303(d) for sediment problems.
- Eel WAA—Instream habitat limitations include high water temperatures, low instream cover levels, and low LWD abundance (PALCO, 1998). Also, the Eel River is listed under Section 303(d) for sediment and water temperature problems.
- Bear-Mattole WAA—Stream aquatic habitat limitations include high embeddedness, high water temperatures, low percent canopy, low percent pools, and low percent instream cover (PALCO, 1998). Also, the Mattole River is listed under Section 303(d) for sediment and water temperature problems. In addition, the Mattole Sensitive Watershed Group (1996), in a nomination to the BOF, proposed the Mattole River as a sensitive watershed (Section 3.4). Two critical limiting factors identified in the petition included high water temperatures and excessive fine sediments.

PALCO (1998) identified a sixth WAA (WAA 6), but did not describe the aquatic habitat in this WAA due to the small proportion PALCO owns (3,586 acres) and the dispersed nature of the small parcels. The streams in this WAA are mainly either Class II or III (Table 3.8-1). However, small portions of Class I streams, approximately 0.6 and 2.9 miles, are present in the Butler Valley and Iaqua Buttes HUs, respectively (see Table 3.8-1). These streams flow into the Mad River, which is Section 303(d) listed for sediment and turbidity problems. In addition, on February 11, 1998, CDF (1998) listed Freshwater Creek, Elk River, Bear, Jordan, and Stitz creeks (portions of

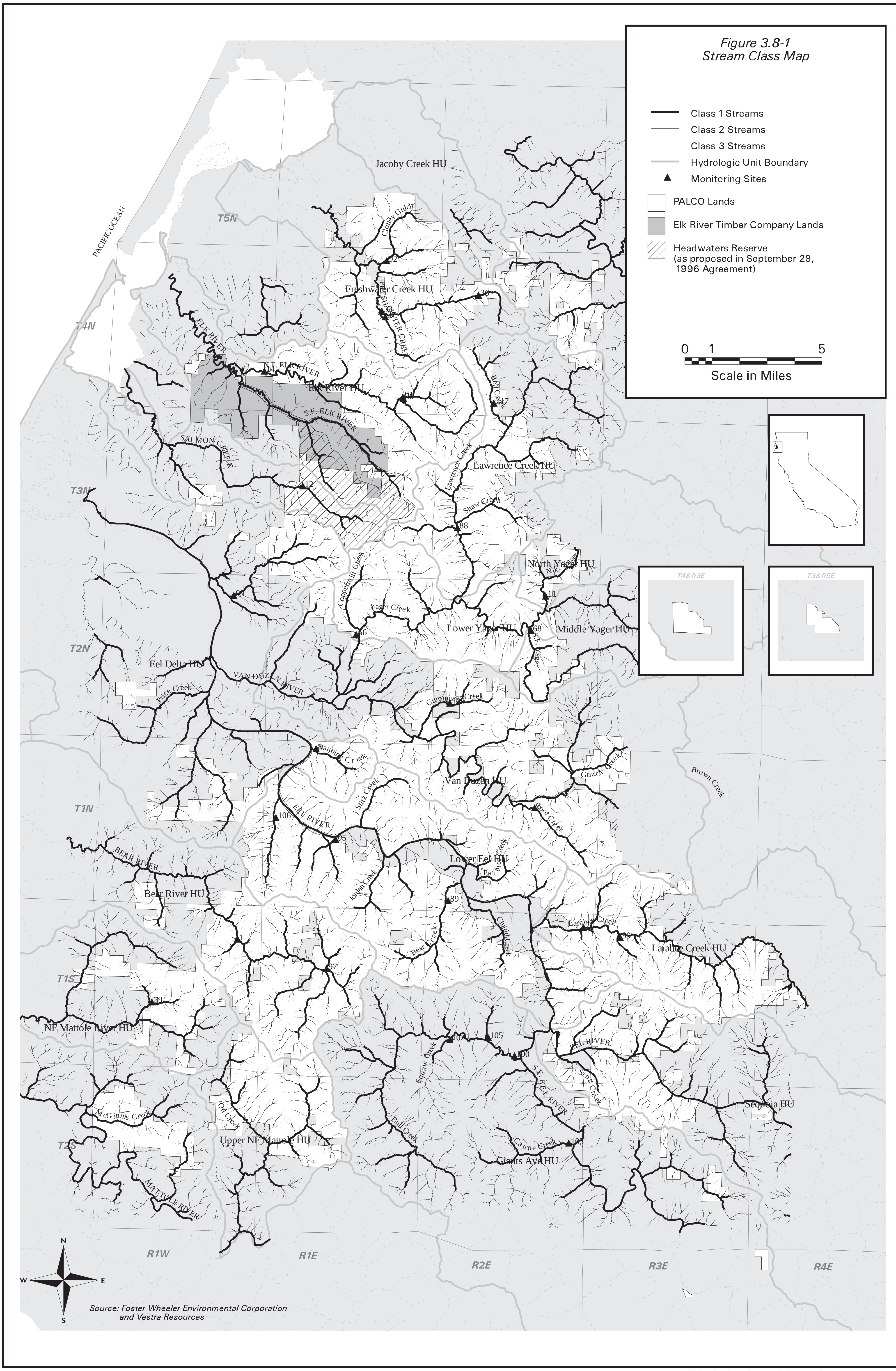

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Table 3.8-1. Stream Miles on PALCO Lands

WAA	Hydrologic Unit	Class I	Class II	Class III	Total
Bear/Mattole River	Bear River	22.6	58.8	45.6	127.0
	Mattole Delta	5.0	10.2	9.9	25.1
	NF Mattole River	5.0	17.7	15.0	37.7
	Upper NF Mattole	9.6	31.2	25.0	65.8
Bear/Mattole River Total		*42.2*	*117.9*	*95.5*	*255.6*
Eel River	Eel Delta	12.6	39.7	27.4	79.7
	Giants Ave	1.2	4.9	4.3	10.4
	Larabee Creek	21.5	62.7	43.9	128.1
	Lower Eel	30.9	130.8	91.5	253.2
	Sequoia	13.7	42.1	30.8	86.6
Eel River Total		*79.9*	*280.2*	*197.9*	*558.0*
Humboldt Bay	Elk River	21.5	49.2	49.4	120.1
	Freshwater Creek	21.8	56.7	38.7	117.2
	Jacoby Creek	0.0	1.6	0.9	2.5
	Other	0.0	0.1	0.2	0.3
	Salmon Creek	0.7	1.8	1.5	4.0
Humboldt Bay Total		*44.0*	*109.4*	*90.7*	*244.1*
Mad River	Butler Valley	0.6	6.1	3.9	10.6
	Iaqua Buttes	2.9	9.5	5.7	18.1
Mad River Total		*3.5*	*15.6*	*9.6*	*28.7*
Van Duzen River	Van Duzen WAA	30.4	83.3	65.7	179.4
Van Duzen River Total		*30.4*	*83.4*	*65.7*	*179.4*
Yager Creek	Lawrence Creek	25.6	55.9	41.7	123.2
	Lower Yager	19.6	51.6	46.7	117.9
	Middle Yager	7.2	6.2	6.3	19.7
	North Yager	3.5	9.2	7.5	20.2
Yager Creek Total		*55.9*	*122.9*	*102.2*	*281.0*
Grand Total		*256.0*	*729.2*	*561.6*	*1,546.8*
Elk River Timber Company Lands Transfer to PALCO					
Humboldt Bay	Elk River	8.0	22.3	14.0	44.3
PALCO HCP Grand Total		*264.0*	*751.5*	*575.6*	*1,591.1*
Headwaters Reserve (not included above)					
Eel River	Eel Delta	0.0	0.1	0.2	0.3
Eel River Total		*0.0*	*0.1*	*0.2*	*0.3*
Humboldt Bay	Elk River	2.8	10.9	5.1	18.8
	Salmon Creek	4.2	10.1	7.9	22.2
Humboldt Bay Total		*7.0*	*21.0*	*13.0*	*41.0*
Grand Total		***7.0***	***21.1***	***13.2***	***41.3***
Elk River Timber Company Lands Transfer to Headwaters Reserve					
Humboldt Bay	Elk River	9.6	5.5	4.1	19.2
Headwaters Grand Total		**16.6**	**26.6**	**17.3**	**60.5**

Source: Foster Wheeler Environmental Corporation

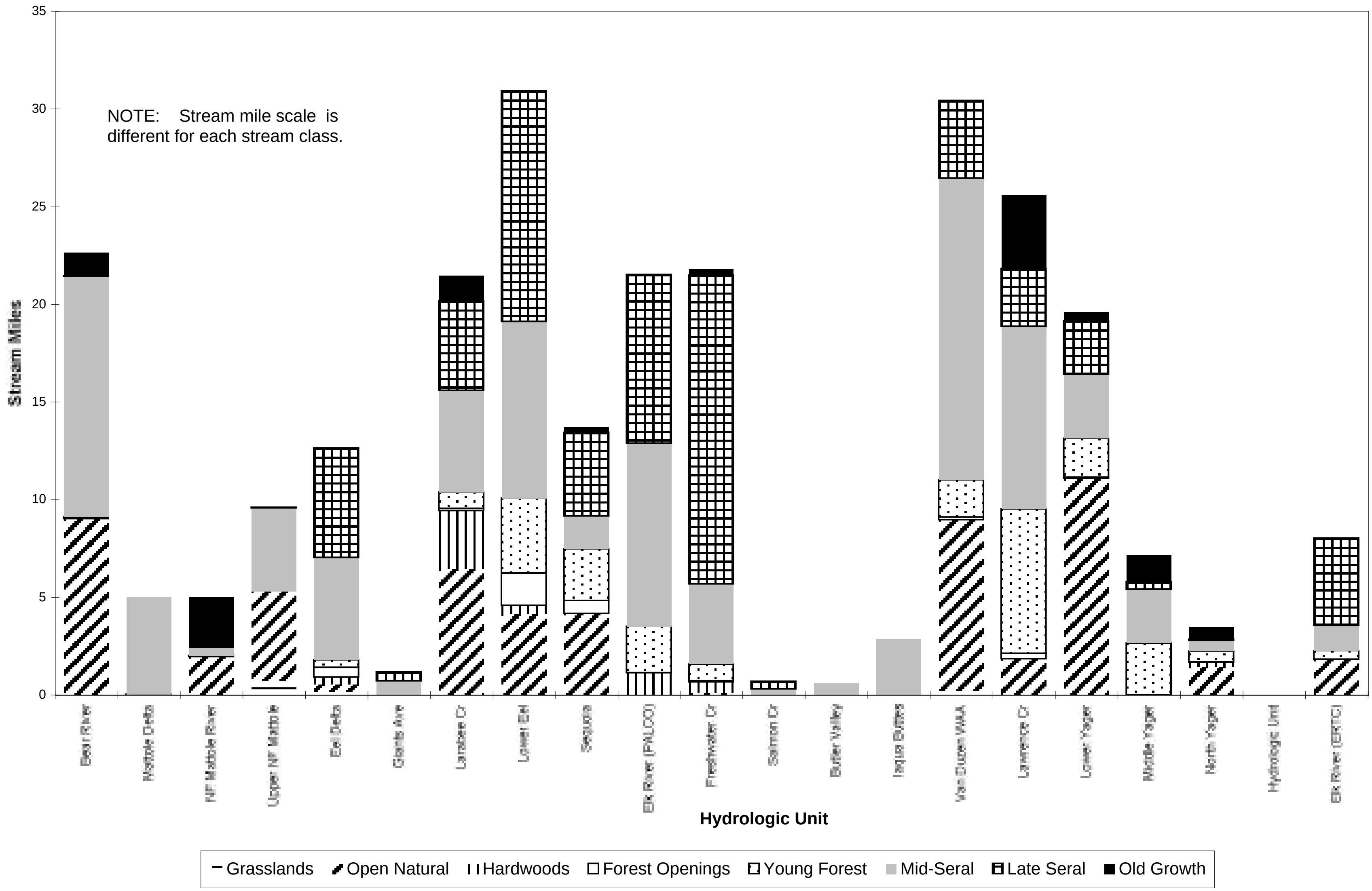


Figure 3.8-2a. Seral Stage Along Class I Streams in the HCP Planning Area (PALCO and Elk/PALCO Lands)

Source: Foster Wheeler Environmental Corporation and Vestra (data)

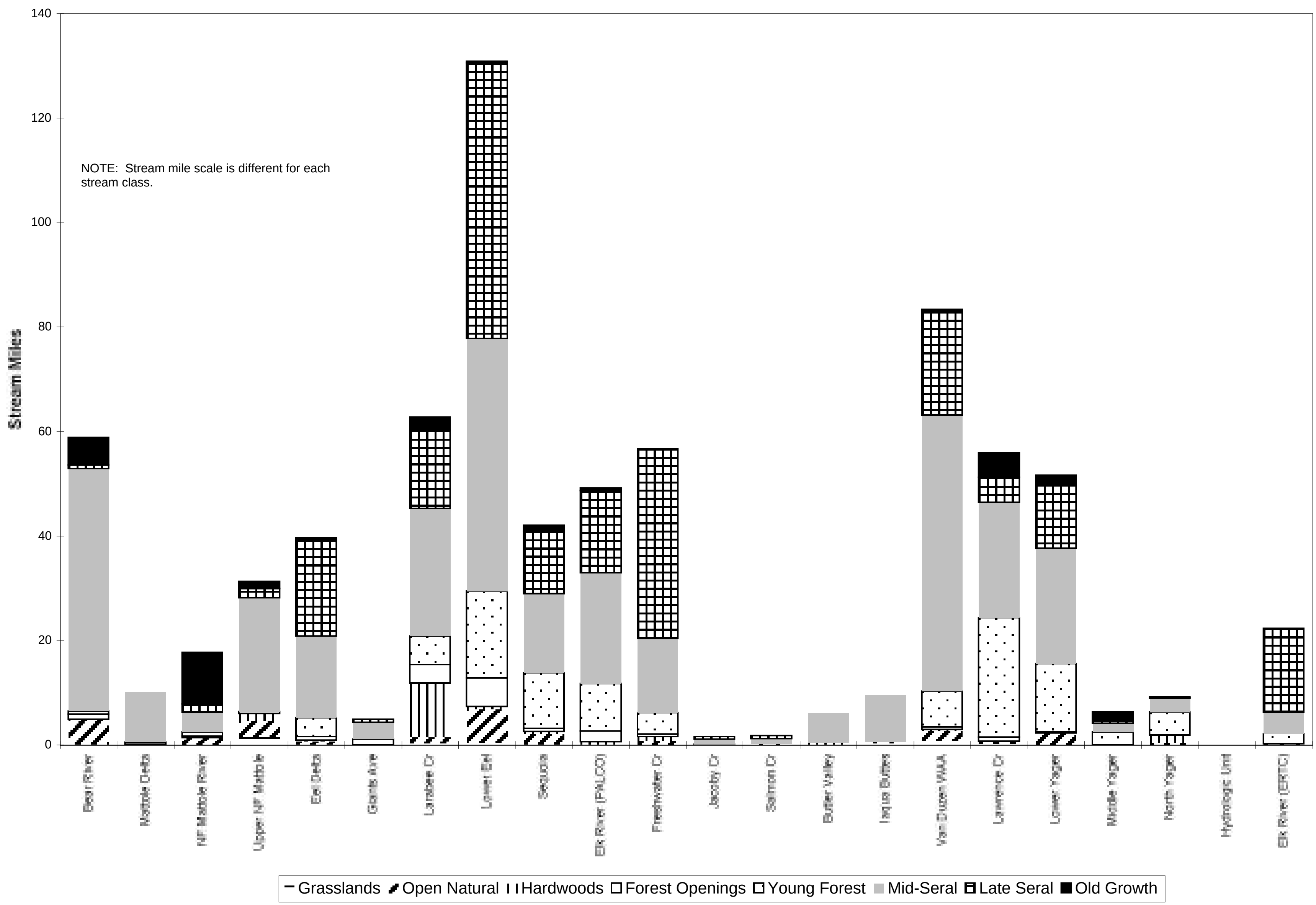


Figure 3.8-2b. Seral Stage Along Class II Streams in the HCP Planning Area (PALCO and Elk/PALCO Lands)

Source: Foster Wheeler Environmental Corporation and Vestra (data),

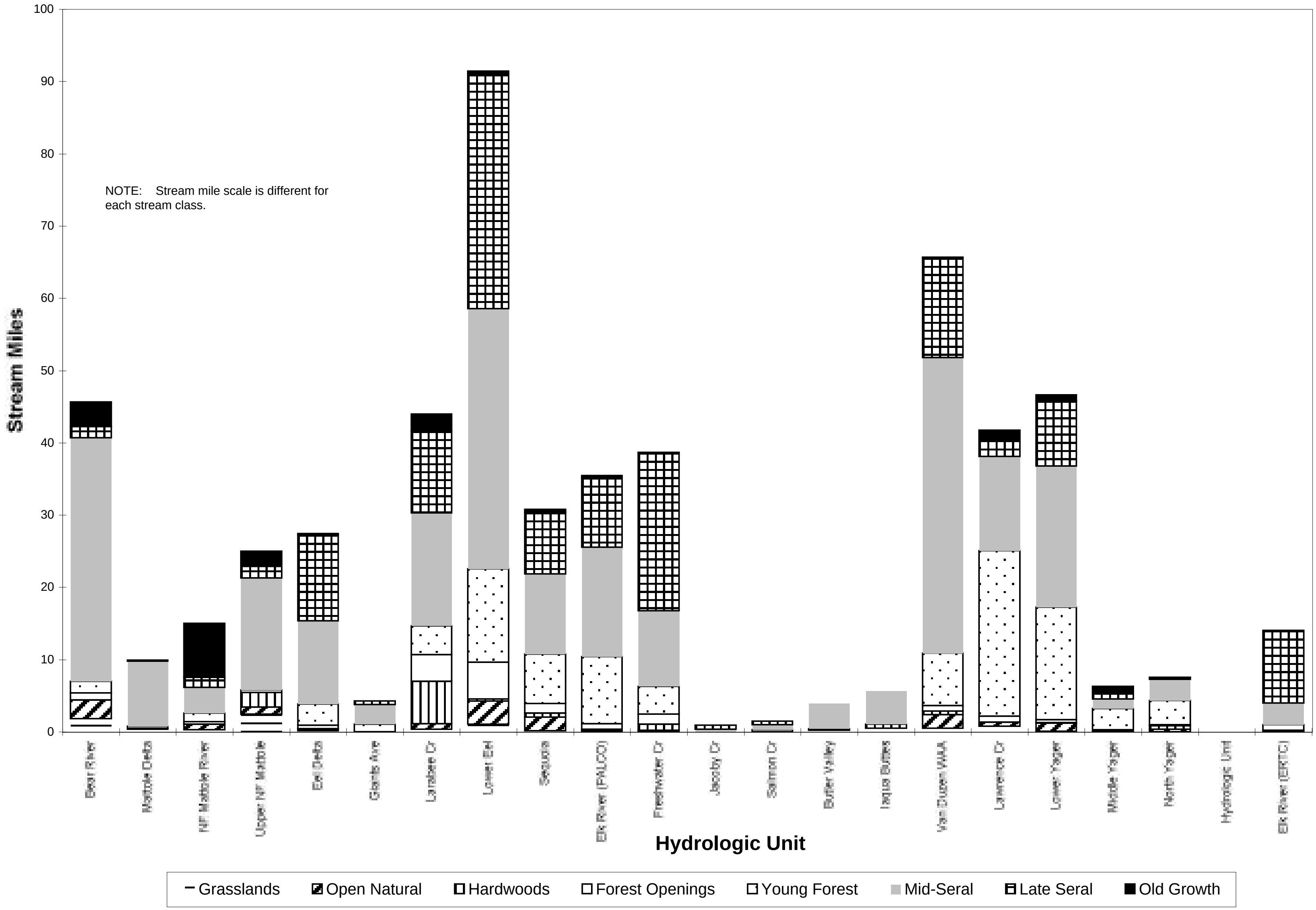


Figure 3.8-2c. Seral Stage Along Class III Streams in the HCP Planning Area (PALCO and Elk/PALCO Lands)

Source: Foster Wheeler Environmental Corporation and Vestra (data) which flow through PALCO property in the Lower Eel HU) as cumulatively affected for sediment problems (see Section 3.4).

Listing under Section 303(d) of the CWA requires the assessment of watershed impacts, identification of actions needed to attain water quality standards, and development of an implementation and monitoring approach that is consistent with CWA requirements (see Section 3.4). These actions are, however, taken in a separate TMDL process (see Section 1.8.1.1).

In-channel Conditions

Since 1989, the CDFG has conducted surveys of stream habitat conditions and fish populations in the five main WAAs that encompass PALCO lands. The surveys were conducted to identify potential sites for stream restoration (Byrne, 1996). The total number of miles CDFG surveyed per watershed on PALCO lands is presented in Table 3.8-2 (adapted from PALCO, 1996).

The data collected provide general indications of physical stream habitat conditions. Parameters include characterization of sediment by percent fines (e.g., sediments less than 0.033 inch or 0.84 mm), water temperature, canopy cover, and stream channel characteristics (e.g., pools per mile, mean pool depth, and maximum pool depth). Some limited information was also collected on woody debris (R2 Resource Consultants, Inc. [R2], 1998). R2 consolidated this information and developed a summary of the ranges and average values for each WAA (see Table 8, Vol. I - Summary HCP/SYP). These conditions confirm the general limitations to aquatic habitat PALCO (1998) identified for each WAA.

PALCO initiated additional monitoring studies on its lands in 1994. The studies were conducted at 46 stream channel and fine sediment (i.e., sediments less than 0.033 inch or 0.84 mm) sampling stations and 28 water temperature stations located throughout PALCO lands. Results of the data collections involving stream channel characteristics, sediment characteristics, and water temperature are presented by R2 (1997).

Large Woody Debris

LWD includes trees and tree pieces greater than 4 inches in diameter and 6 feet long (Keller and Swanson, 1979; Bilby and Ward, 1989). LWD is one of the most important components of high quality fish habitat (Marcus et al., 1990). Also known as large organic debris (LOD), this material provides food and building materials for many aquatic life forms, provides cover for juvenile and adult fish, and is the primary channel-forming element in some channel types (Marcus et al., 1990). The value of LWD in providing aquatic habitat depends on stream size, tree species, and numerous other factors (see Section 3.7).

LWD affects many aspects of streams, including channel morphology, sediment storage, water retention, stream nutrient cycling, macroinvertebrate productivity, and fish habitat (Marcus et al., 1990; Lisle, 1986; Swanson et al., 1984; Martin, et al., 1998). Pools formed by stable accumulations of LWD provide important habitat for rearing salmonids, particularly in winter (Heifetz et al., 1986; Murphy et al., 1986). LWD loadings are also important for salmonid survival at high flows (Robison and Beschta, 1990). Coho salmon (*Oncorhynchus kisutch*) benefit directly from the habitat cover and pools formed by LWD, particularly during juvenile rearing.

Increased numbers of rearing coho have been directly related to the amount of LWD available for use in a stream (Bisson, et al., 1987; Murphy, 1995). LWD may also be beneficial to adult salmonids that use it for resting sites and escape cover. It can form areas of deposition as well as scour, which

Table 3.8-2. Stream Areas Surveyed by CDFG for In-channel Conditions on PALCO Lands

WAA	Surveyed Miles	Total Miles (Class I and II) on PALCO Lands	Percent Distance Surveyed
Humboldt	50.0	226.8	22
Yager	58.0	178.8	32
Van Duzen	18.5	113.8	16
Eel	72.3	360.2	20
Bear-Mattole	8.2	160.1	5
Total	207.0	1,039.7	20

Source: Foster Wheeler Environmental Corporation

can enhance spawning through gravel sorting (Flosi and Reynolds, 1994). In addition, it can trap and hold post-spawned fish carcasses, enabling more effective recycling of nutrients into the aquatic system (compared to carcasses that are washed downstream) (Cederholm and Peterson, 1985). Large accumulations of LWD in streams in the form of logging slash, however, may be undesirable and may block fish passage in extreme cases. Logging slash may include larger tree branches and short sections of wood without rootwads. Much of this type of LWD floats and, therefore, can be unstable (Bryant, 1980). Unstable accumulations of LWD can wash out and destabilize streambanks, potentially causing reductions in fish habitat and overall stream productivity.

From the 1950s through the 1970s, forest management practices often included removal of LWD from streams based on the belief that it was detrimental to salmon migration. This resulted in major changes in the amount of cover habitat available and often changed stream habitats to a single, cobble-bed channel lacking pools and LWD or to bedrock channels lacking gravel, woody debris, and other channel features (Murphy, 1995). This decrease in LWD corresponds to a reduction in salmonid use (House and Boehne, 1987).

Due to the time required for streamside trees to grow and mature to potential LWD, there may be a considerable lag period (e.g., greater than about 50 years and up to 300 years) before additional LWD is contributed to a cleared stream (Gregory and Bisson, 1997). Stream clearing with accompanying replacement of structures (e.g., wood and large rocks) continued into the 1990s in the vicinity of the HCP planning area (Personal communication, S. Downie, CDFG [Redway], 1997).

In general, information on LWD must be viewed from the perspective of the timber harvest activity in the area, historic floods that have removed or redistributed LWD, and the activities that were performed to actively remove LWD (see Section 3.7). Potential LWD recruitment from existing mature or old-growth riparian zones would be anticipated to be higher than younger or recently clearcut areas (see Section 3.7). There may be no potential for LWD recruitment in currently open areas such as prairies and grasslands, which may not develop into forested area in the foreseeable future.

CDFG has collected limited information on LWD during its stream habitat surveys in the WAAs of the PALCO planning area. R2 (1997) summarized these data for PALCO in *Literature Summary of Large Woody Debris*. Values for LWD ranged from less than 1 piece of LWD per 100 feet of stream (e.g., some streams in the Eel River drainage) to over 15 pieces per 100 feet (e.g., portions of the South Fork of Freshwater Creek).

In addition to streamside management activities (e.g., timber harvest) that influence the potential recruitment of LWD, hydrology, size and type of debris, and channel morphology are major factors in retaining it. For example, LWD is less effective in forming pools and trapping gravel in confined channels with boulder and bedrock substrate than in alluvial channels (Martin, et al., 1998).

Field studies in old-growth, Douglas-fir forest streams in coastal Oregon and Washington have shown that the number of woody debris pieces varies by channel width and size of debris under undisturbed conditions. For example, studies by Bilby and Ward (1989) and Fox (1994) show that the number of LWD pieces decreased with increasing width of a stream (see Appendix K). Similarly, the average diameter, length, and volume increased. The type of wood is an important factor (see Section 3.7). For example, coniferous wood (e.g., Douglas-fir or redwood) is more resistant to decay than deciduous wood (e.g., alder). Therefore, coniferous wood has a greater longevity in a stream (Cummins et al., 1994, as quoted in Spence et al., 1996).

The actual number of LWD pieces that would provide properly functioning habitat conditions depends highly on site-specific factors. To obtain levels of LWD that are properly functioning, the goal is to maintain streamside RMZ conditions that provide potential LWD recruitment, not necessarily specific instream numbers (see Appendix K). Prescriptions developed from watershed analysis (see Section 3.7) can be used to more clearly refine site-specific needs.

Bedload

A certain amount of bedload material is necessary to provide substrate for cover and spawning habitat for fish. For example, anadromous salmon typically use gravels ranging from 0.5 to 4 inches (12.7 to 101.6 mm), whereas steelhead and resident trout may use smaller substrates ranging from 0.25 to 4 inches (6.4 to 101.6 mm) (Bjornn and Reiser, 1991). Increased levels of bedload above background levels can, however, lead to stream channel instability, pool filling by coarse sediment, or introduction of fine sediment to spawning gravel (Spence et al., 1996).

Fine sediment (0.004 to 0.033 inch or 0.1 to 0.84 mm in diameter) can reduce stream habitat quality, restrict sunlight penetration, and fill pores between the gravel, thus preventing the flow of oxygen-rich water to fish eggs that may be deposited in the gravel. Fine sediments and larger particles (up to about 0.27 inch [6.84 mm] or sand-sized fractions) can also smother fish eggs and developing young in the gravel. In addition, they may also clog pores or breathing surfaces of aquatic insects, physically smother them, or decrease available habitat (Spence et al., 1996; Nuttall and Bielby, 1973; Bjornn et al., 1974; Cederholm et al., 1978; Rand and Petrocelli, 1985). Factors influencing the excessive delivery of sediment to a stream include (1) the intensity and location of erosion and mass-wasting events, and (2) the presence of adequate streamside vegetation to filter fine sediment derived from hillslopes and road erosion (see Sections 3.6 and 3.7).

Field information collected by CDFG (1997a) and PALCO (1998) shows a wide range of fine sediment levels for streams on PALCO lands (R2, 1998). Sites that had greater than 20 percent fines (particles smaller than 0.033 inch or 0.84 mm) were found in a majority of the planning watersheds studied. In laboratory studies, a substrate containing 20 percent fines was found to reduce emergence success of young salmon and trout by 30 to 40 percent (Phillips et al., 1975; MacDonald et al., 1991). According to study results and summaries from Peterson et al. (1992) and Chapman (1988), a properly functioning aquatic habitat would have substrates that contain less than 11 to 16 percent particles smaller than 0.033 inch or 0.85 mm (see Appendix K).

Water Quality and the Aquatic Ecosystem

Favorable water quality is an important component of a properly functioning aquatic system. Changes in water quality can affect the survival and production of many fish and other aquatic species. Key water quality parameters affecting fish survival include water temperature, dissolved oxygen (DO), turbidity, and potential contaminants. Specific information and data on water temperature from the streams on PALCO lands and the surrounding area are available (see Section 3.4); however, there is little or no consistent information on DO, turbidity, or potential contaminants.

Water temperature plays an integral role in the biological productivity of streams. Limited water temperature data from the PALCO planning area are available (see Section 3.4). From analysis of water temperatures collected at 29 stations, temperature criteria for coho salmon (specifically MWAT values—see Section 3.4 and Appendix K) generally were exceeded in eight locations, including Bear Canoe, Carabee, and Rodgers, creeks, North Fork Yager Creek, the Bear River, and the North Fork Elk River (see Table 3.4-5). These values were associated with the location of sampling sites in reaches with less than 30 percent canopy cover, which indicates that stream shading is an important factor that influences stream temperatures.

Water temperature fluctuations and their relationship to DO can affect all aspects of salmon and trout life histories in fresh water, from incubation and egg survival in stream gravel to the emergence, feeding, and growth of fry and juvenile fish, to adult migration, holding, and resting prespawning and spawning activities, and outmigration of young fish. A rise in temperature increases the metabolic rate of aquatic species, especially cold-water species such as salmon and trout. In addition, DO decreases as water temperature increases, potentially increasing stress on fish. Water temperatures in the range of 70°F (about 21°C) or greater can cause death in cold-water species such as salmon and trout within hours or days (DEQ, 1995). In general, water temperatures of 53.2 to 58.2°F (11.8 to 14.6°C) have been found to provide a properly functioning condition for juvenile salmon and trout (see Appendix K). Similar or cooler temperatures may be required for amphibians (see Section 3.10).

Increases in water temperature in forest streams can often be traced to reduction of shade-producing riparian vegetation along fish-bearing and tributary streams that supply water to other fish-bearing streams. Section 3.4 describes existing water temperatures in streams on PALCO and surrounding lands. In addition, water temperatures can be affected by stream widening, sedimentation/stream depth, microclimate, groundwater, and other upstream inputs (see Section 3.4).

Cumulative effects of elevated water temperatures in several tributaries can result in loss of mainstem rearing habitat downstream (Brown, 1985). Another effect is the long-term versus short-term effect of warm-water temperatures on cold-water aquatic species. Heat stress may cumulate such that increased exposure for juvenile fish in an environment in which growth is reduced or unable to meet increased metabolic demands increases their susceptibility to disease (DEQ, 1995).

Adequate DO levels are important for supporting fish, invertebrates, and other aquatic life. Salmonids are particularly sensitive to reduced DO (DEQ, 1995). Management-induced depletion of DO in stream water can occur from harvest activities, such as excessive amounts of logging debris left in a stream that can result in decreased DO (MacDonald et al., 1991). DO concentrations can also be decreased by high summer temperatures, low flows, sediment, and algal blooms (see Section 3.4).

Forest management activities are more likely to affect intergravel DO through increases in fine sediment. For example, intergravel DO concentrations have been found to be reduced as a result of timber harvest (Bjornn and Reiser, 1991; Ringler and Hall, 1975; Moring, 1975). Intergravel DO has been recognized as crucial to the survival of salmonid embryos, but current criteria do not directly incorporate a water quality standard that addresses intergravel DO concentrations.

Intergravel DO depends on several interrelated factors such as surface-water concentrations, percentage of fine sediment and gravel in pores, and the oxygen demand of the eggs. Critical levels of DO also depend on the velocity of the water passing the eggs, as less oxygen is needed at higher velocities (DEQ, 1995). Site-specific data on surface water or intergravel DOs have not been recorded for PALCO lands.

Biological effects of increased turbidity may include a decrease in primary productivity of algae and periphyton due to the decrease in light penetration. Declines in primary productivity can adversely affect the productivity of higher trophic levels such as macroinvertebrates and fish (Gregory et al., 1987). Turbidity can also interfere with feeding behavior or cause gill damage in fish (Hicks et al., 1991), but may provide some positive benefits. For example, it can provide cover from predators (Gregory and Levings, 1998). Little information is available on turbidity levels in streams on PALCO lands.

Water quality contaminants (e.g., petroleum products, chemicals, sewage, and heavy metals) can severely impair aquatic ecosystems either by sublethal (e.g., reduced growth) or lethal effects (e.g., fish kills). PALCO lands are primarily located in forested headwater areas with no industrialization or urbanization upstream. Therefore, the occurrence of contaminants is likely to be low. Herbicides may be used. In the future, however, they would be controlled through regulations and agency review (see Section 3.14). In addition, spills of contaminants (e.g., petroleum products) are possible on roads, landings, or skid trails. Information is available on herbicides (see Section 3.4). Specific information on other contaminants is not available for PALCO lands.

Stream Flow

The amount of water provided to aquatic ecosystems at critical times is important for sustaining fish and other aquatic species. Many fish have become adapted to natural flow cycles for feeding, spawning, migration, and survival needs. The timing, magnitude, and duration of peak and low flows must be sufficient to create and maintain riparian and aquatic habitat. Flows can be influenced by management activities such as timber harvest and roads (see Sections 3.4 and 3.6). In general, low- or base-level stream flows that occur during the late summer often limit habitat for rearing juvenile salmon and trout. They can also negatively affect migration and access to habitat and food resources, as well as disrupting spawning behavior. Such conditions can occur naturally during this period due to lack of precipitation. However, low flows can be exacerbated by water withdrawals, silting (which can decrease pool depth), and stream widening resulting from unstable banks.

High winter flows and floods that scour the streambed can be detrimental to eggs or young fish that may be incubating in the stream gravels. Both extreme high and low flow conditions may occur in the region of the proposed HCP planning area. For example, the Eel River near Scotia has recorded discharges that range from 1.2 cubic feet per second (cfs) in September 1977 to a high of 648,000 cfs that was recorded during floods in December 1964.

Fish Passage

Upstream migration of adult salmon, steelhead, and trout to spawning areas or redistribution of rearing fish to potential habitat in upstream areas can be impeded or blocked by a number of different mechanisms. These mechanisms can include the following:

- *Water Temperature*—Elevated water temperatures (e.g., greater than 68°F [20°C] or 60°F [15.6°C] for fall chinook salmon and coho salmon, respectively) are known to stop the migration of fish (Bjornn and Reiser, 1979).
- *DO*—At least 5 mg/l of DO is recommended to provide oxygen needs for migrating fish (Bjornn and Reiser, 1979). Decreased oxygen can occur as a result of high water temperatures and oxygen consumption created by decay of organic debris, chemicals, and respiration.
- *Turbidity*—High levels of sediment (e.g., 4,000 mg/l) have been reported (Bjornn and Reiser, 1979) as ceasing upstream migration.
- *Physical Barriers*—High waterfalls or cascades that are beyond the jumping or physical capabilities of fish, can prevent upstream migration. Similarly, excessive water velocities that result in conditions that are beyond the physical capabilities of a given fish species can also restrict or prevent upstream migration. The maximum velocity beyond which coho and chinook salmon cannot successfully move upstream is about 8 feet per second (2.44 meters per second) (Reiser and Bjornn, 1979).

Shallow water depths from conditions such as low flow can impede or prevent passage (e.g., upstream migration of chinook or coho salmon is not generally successful at depths less than about 0.8 foot (0.24 meter) or 0.6 foot (0.18 meter), respectively (Bjornn and Reiser, 1979). Such conditions can occur during low flow periods where riffles between pools can become completely dry or lack sufficient depth for passage. Other barriers can include culverts used at stream crossings that prevent passage due to high water velocities, restricted depths, excessive elevation for successful entry, size and length, and other factors. Similarly, debris jams can prevent or delay upstream passage (Bjornn and Reiser, 1979).

Channel Morphology

Channel morphology is the shape and form of the stream bed and its associated banks. Natural channels are complex and contain a mixture of habitats differing in depth, velocity, and cover (Bisson, et al. 1987). They are formed during storm events that have associated flows which mobilize sediment in the channel bed (Murphy, 1995). The hydrologic regime of a watershed, combined with its geology (which influences the channel and determines sediment supply), hillslope characteristics, and riparian vegetation determines the nature of stream channel morphology (e.g., number and spacing of pools and width-to-depth ratio) (Beschta et al., 1995; Sullivan et al., 1987). Therefore, activities in these areas would be expected to affect the shape and form of the stream channel. For example, substantial increases in volume and frequency of peak flows can cause streambed scour and bank erosion. A large sediment supply may cause aggradation and widening of the stream channel, pool filling, and a reduction in gravel quality (Madej, 1982). Upslope activities (e.g., timber harvest, land clearing, and road development) can change channel morphology by altering the amount of sediment or water contributed to the streams. This, in turn, can disrupt the balance of sediment input and removal in a stream (Sullivan et al., 1987).

Pool/Riffle Structure

Streams that lack a balance between pools and riffles are often less productive than streams that have more complex structure. Pools are used as holding and resting areas for adult fish prior to spawning, deep water cover for protection, and cool water refugia during low flow summer months. Riffles are important for reoxygenation of water, habitat for food organisms such as aquatic macroinvertebrates, and as rearing areas for fish (Gregory and Bisson, 1997). Intensive timber harvest has been reported to decrease pool depth, surface area, and the general diversity of pool character (Ralph et al., 1994). Possible mechanisms include decreased occurrence of LWD (which can help form and stabilize pools) and filling of remaining pools with bed material.

A range of optimum pool-to-riffle ratios for a properly functioning system has been described in the literature (Appendix K). Applying any values within this range to field conditions would require considering site-specific characteristics such as existing LWD, stream gradient, bank characteristics, sediment load, bed material (e.g., bedrock and boulders), and other watershed factors such as hydrologic conditions (Murphy, 1995).

Floodplain/Backwater/Side Channel Connectivity

Floodplains are an important component of aquatic habitat. They provide overwintering habitat and refuge from high flows for fish, as well as input of organic matter and LWD. Seasonally flooded channels and ponds are particularly important for rearing coho salmon and other fish species during winter months. Large floodplains can also function as filters for subsurface flows and maintenance of water quality (Gregory and Bisson, 1997). Major floodplains in the planning area generally are located in the lowest reaches of the major rivers, including the Eel River (which is the largest), Van Duzen River (for most of its length in PALCO lands and downstream to its confluence with the Eel), Yager Creek near Carlotta, Mattole River, Bear River, Salmon Creek, Elk River, Freshwater Creek, Larabee Creek, and Jacoby Creek. Topographic and geologic maps indicate that most of the extensive floodplains are located downstream from PALCO lands (see Section 3.4).

3.8.2.2 Stream Habitat and Fisheries Projects

Projects to assess and restore stream habitat conditions for salmon and trout have been implemented in several regions within the HCP planning area. These have been conducted in cooperation with the CDFG and include the following:

- *PALCO*—Operates fish rearing facilities used to produce trout and salmon fry and outmigrants for release into streams on its ownership (PALCO, 1998). Operations focus on egg collection from wild fish, hatchery conditions that mimic natural stream conditions, releases of fry instead of older fish, and disease control. The hatchery facilities are intended to aid the establishment of self-sustaining populations of wild fish and will be used in the future only as long as they have a positive impact on wild fish populations (PALCO, 1998). Future operation of these facilities will be covered by a Section 10(a)(1)(A) FESA permit because the operations would potentially affect an FESA-listed species (i.e., coho salmon). In addition, the fish hatchery will not be covered under the HCP ITP. Instead, it will be included as part of the assessment of the state hatcheries and hatchery program.

PALCO (1998) has also undertaken numerous stream enhancement/ restoration projects since 1987. (See Map 19, Vol. V and Part G, Vol. II of the HCP/SYP). These efforts have included access improvements, bank stabilization structures, and in-stream channel enhancements.

- *Humboldt Fish Action Committee*—Operates a weir on Freshwater Creek and conducts stream restoration activities. This group also conducts stream assessment and fish population surveys throughout the Freshwater Creek watershed.
- *Mattole Watershed Salmon Support Group*—Conducts extensive stream assessment, planning, and restoration activities in the Mattole River watershed. The primary emphasis of this group is to protect, enhance, and restore wild, indigenous salmonid populations and the ecosystems that sustain them in the Mattole River watershed. Projects include trapping, holding, spawning, and rearing operations to increase juvenile salmonid outmigrant numbers.

3.8.2.3 Fish

Species Present

Table 3.8-3 lists the fish species recorded in streams on PALCO lands and adjacent areas. The table also provides the federal or state status or the levels of concern as identified by Moyle et al. (1995). The list focuses on species that spend their entire lives in freshwater or anadromous forms that spend part of their life cycle in freshwater. Species that predominantly live in either the estuarine or marine environment are not included. One exception, the tidewater goby, is a federally listed species that occurs in the estuarine areas and lagoons along the north coast of California (Moyle et al., 1995).

Priority Fish Species for Evaluation

Coho and chinook salmon, cutthroat trout, and rainbow/steelhead trout were considered the priority group for evaluation of potential effects from the alternatives. The HCP (PALCO, 1998) identified these as “List A Species.” Also included as a List A species was Pacific lamprey. While there is some information available regarding the natural history of this species, few data exist regarding its occurrence on PALCO lands, and little information is available with which to judge the impacts of the taking or the effectiveness of proposed mitigation. Pacific lamprey will not be included in the ITP.

The priority fish species are also the primary species addressed in the proposed HCP. They were selected for evaluation because historically they have been a major target for harvest by sport, commercial, or Native American fishermen. In addition, they depend on high-quality freshwater habitat for migration, spawning, egg incubation, rearing, and overall survival. Therefore, they are considered sensitive to land uses that may decrease the natural functions of an aquatic ecosystem.

Table 3.8-4 presents the general life history characteristics of the priority species. The characteristics can vary significantly in different locations depending on climate, food supply, stream flow, and other factors (Flosi and Reynolds, 1994). Figure 3.8-3 (a, b, c, and d) shows the distributions of the

Table 3.8-3. Current Status of Fish Species Recorded in Streams on PALCO Lands and Adjacent Areas

Fish Species	Federal Status[1/]	State Status[2/]	Level of Concern (Moyle et al. 1995)[3/]
Coho salmon (*Oncorhynchus kisutch*)	FT (April 1997)	CCT	M1
Chinook salmon (*O. tshawytscha*)	PFT	CSSC	M1/M2
Steelhead/rainbow trout (*O. mykiss*)	Rejected for listing March 14, 1998 (Currently holds candidate status)	CSSC	M1/M2
Coastal cutthroat trout (*O. clarki clarki*)	FSR	CSSC	M2
Coastal prickly sculpin (*Cottus asper*)	-	-	M4
Coastrange sculpin (*C. aleuticus*)	-	-	M4
Pacific lamprey (*Lampetra tridentata*)	SC	-	M4
Sacramento sucker (*Catostomus occidentalis humboldtianus*)	-	-	M4
Sacramento squawfish (*Ptychocheilius grandis*)	-	-	-
California roach (*Lavinia symmetricus*)	-	-	Introduced to area
American shad (*Alosa sappidisima*)	-	-	Introduced to West Coast
Green sturgeon (*Acipenser mediostris*)	SC	-	M1
Threespine stickleback (*Gasterosteus aculeatus*)	-	-	M4
Tidewater goby (*Eucyclogobius newberryi*)	FE	-	M1
Eulachon (*Thaleichthys pacificus*)	-	-	M3
Longfin smelt (*Spirinchus thaleicthys*)	-	-	M1

(Source: Adapted from PALCO, 1996 and Moyle et al., 1995)

Federal[1/]

C = Candidate

FE = Federal endangered species

FT = Federal threatened species

FSR = Status review of species currently being conducted by NMFS

PFE = Proposed for Federal listing as endangered

PFT = Proposed for Federal listing as threatened

SC = Species of concern

State[2/]

CCT = California candidate for listing as threatened

CE = California endangered species

CSSC = CDFG Species of Special Concern

Moyle et. al (1995)[3/]

M1 = Qualifies as endangered or threatened

M2 = Special concern

M3 = “Watch list”

M4 = Secure status

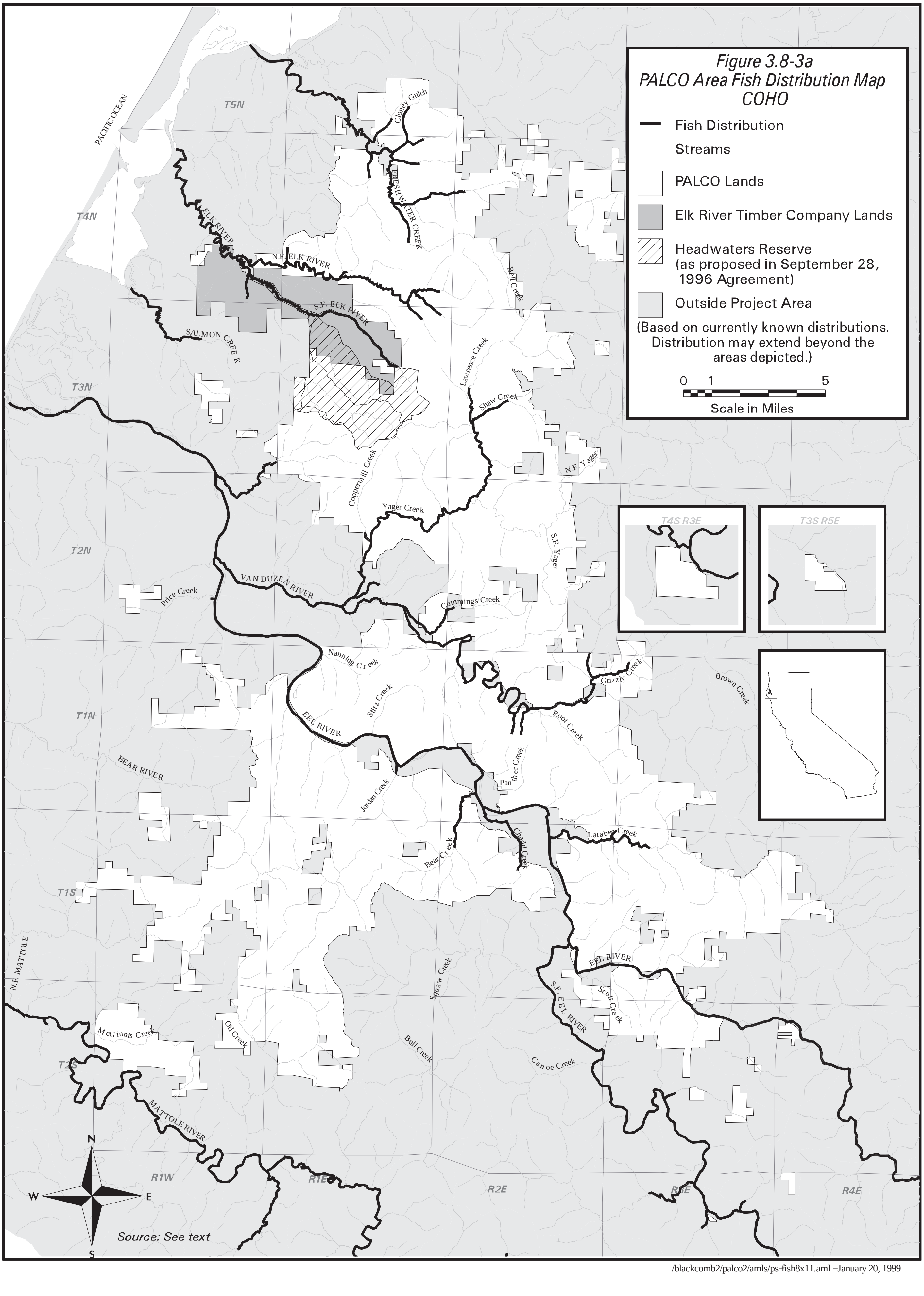
Table 3.8-4. General Life History Characteristics of Salmonids on PALCO Lands and Nearby Areas

Species	Freshwater Rearing	Outmigration	Marine Rearing	Spawning Migration/Spawning
Coho salmon	1 to 2 years	Juveniles migrate downstream in the spring (March-April).	1 to 2 years, attaining a size of about 22-28 in. (55-70 cm).	October through January (primarily November and December)
Chinook salmon	Fall run[1/] usually limited to less than one year	Variable—most juveniles migrate downstream in the spring (March-April); however, some may remain in streams and estuaries and enter the ocean in the fall.	2 to 5 years, attaining a size of about 30-39 in. (75-100 cm).	Late August and early November, depending on adequate stream flows for migration; spawning from October through January
Steelhead trout/rainbow trout	Summer run - 1 to 3 years	Juveniles migrate downstream in the spring (March-June).	2 to 3 years, attaining a size of 19 to 33 in. (48 to 84 cm).	Upstream migration in April-July followed by spawning from December-April
	Winter run - 1 to 2 years, attaining a size of about a "Half-Pounder"[2/]	Same as above. Same as above.	same as above	Upstream migration in November-March; spawning from December - April
Cutthroat trout	Two or more years before downstream migration; some remain residents in freshwater throughout their life	Juveniles migrate downstream in the spring (March-June).	Less than 1 year, attaining a size rarely exceeding 50 cm (20 in.)	Upstream migration from August to October; spawning in winter through the spring

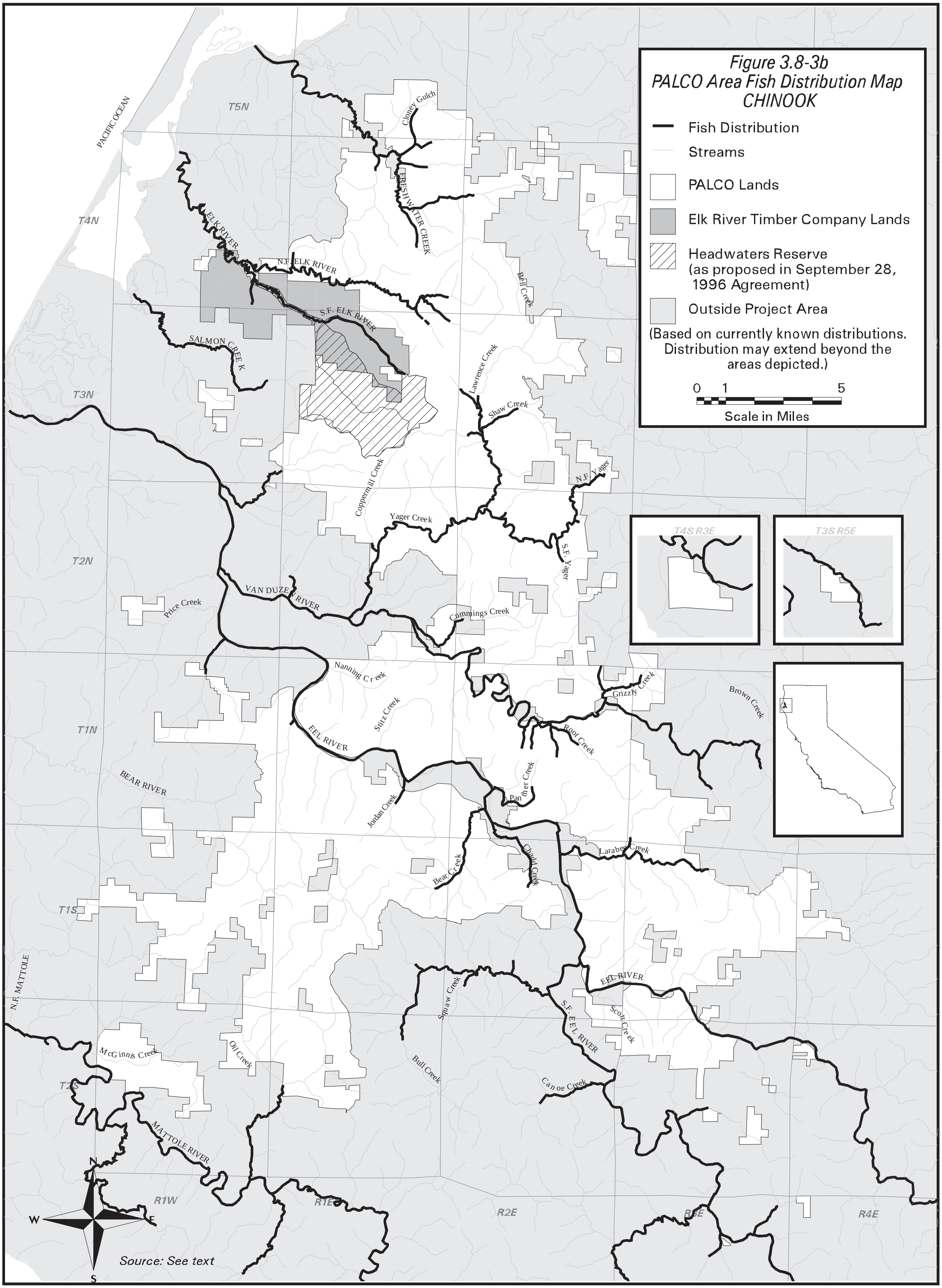
(Source: Adapted from Flosi and Reynolds, 1994; Moyle et al., 1995; and Busby et al., 1996).

1/ According to Moyle et al. (1995) small numbers of spring-run chinook salmon (possibly strays) have been reported in the Mad River, Mattole River, Eel River, and Redwood Creek. There is, however, no evidence of recent spawning.

2/ Found only in the Rogue, Klamath, Mad, and Eel rivers. According to Busby et al. (1996), following downstream migration, "half-pounders spend only 2 to 4 months in the ocean and they return to freshwater. They overwinter in freshwater and emigrate to salt water the following spring." This is believed to be a false spawning migration because few half-pounders are sexually mature.



/blackcomb2/palco2/amls/ps-fish8x11.aml −January 20, 1999



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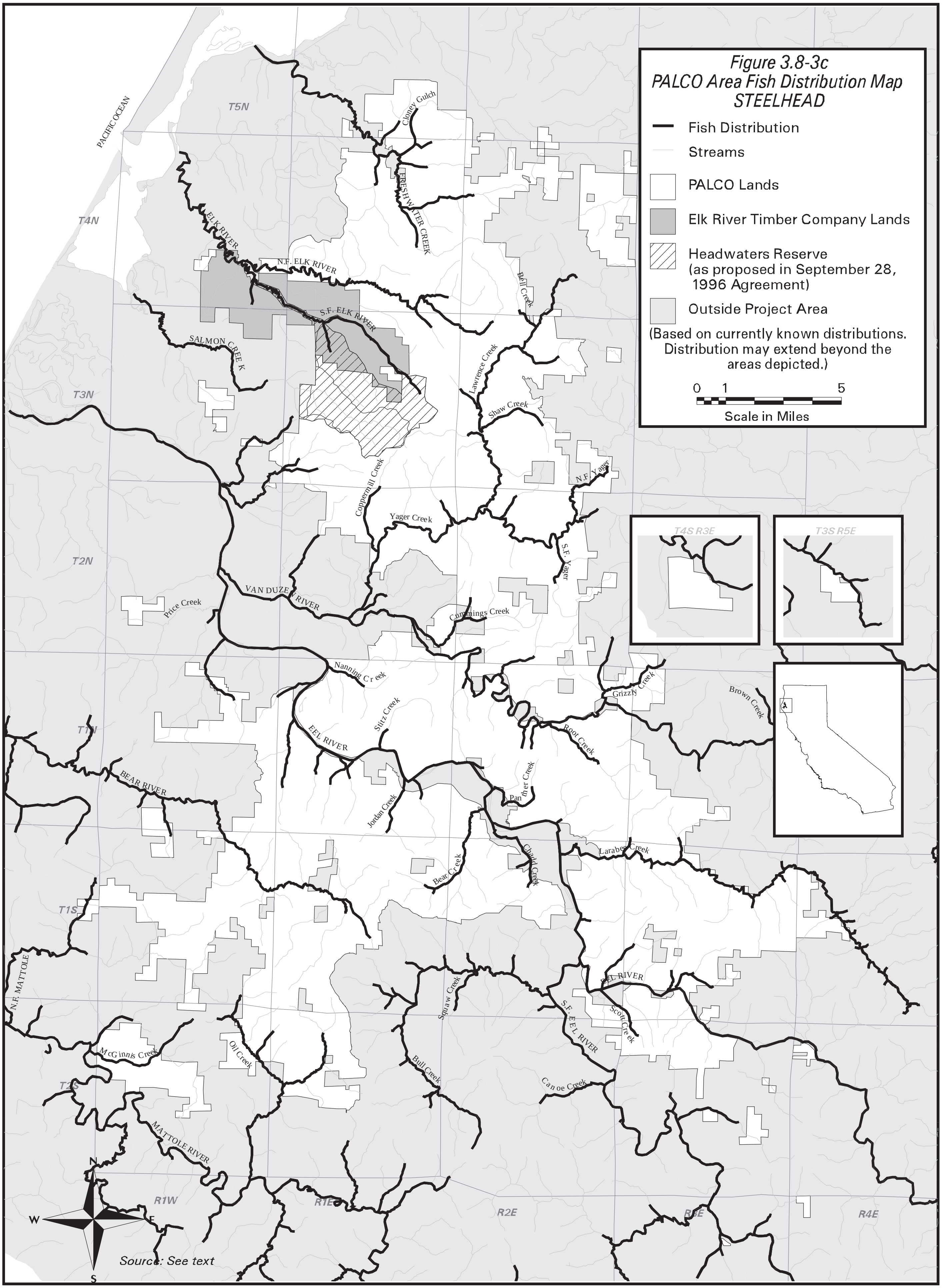
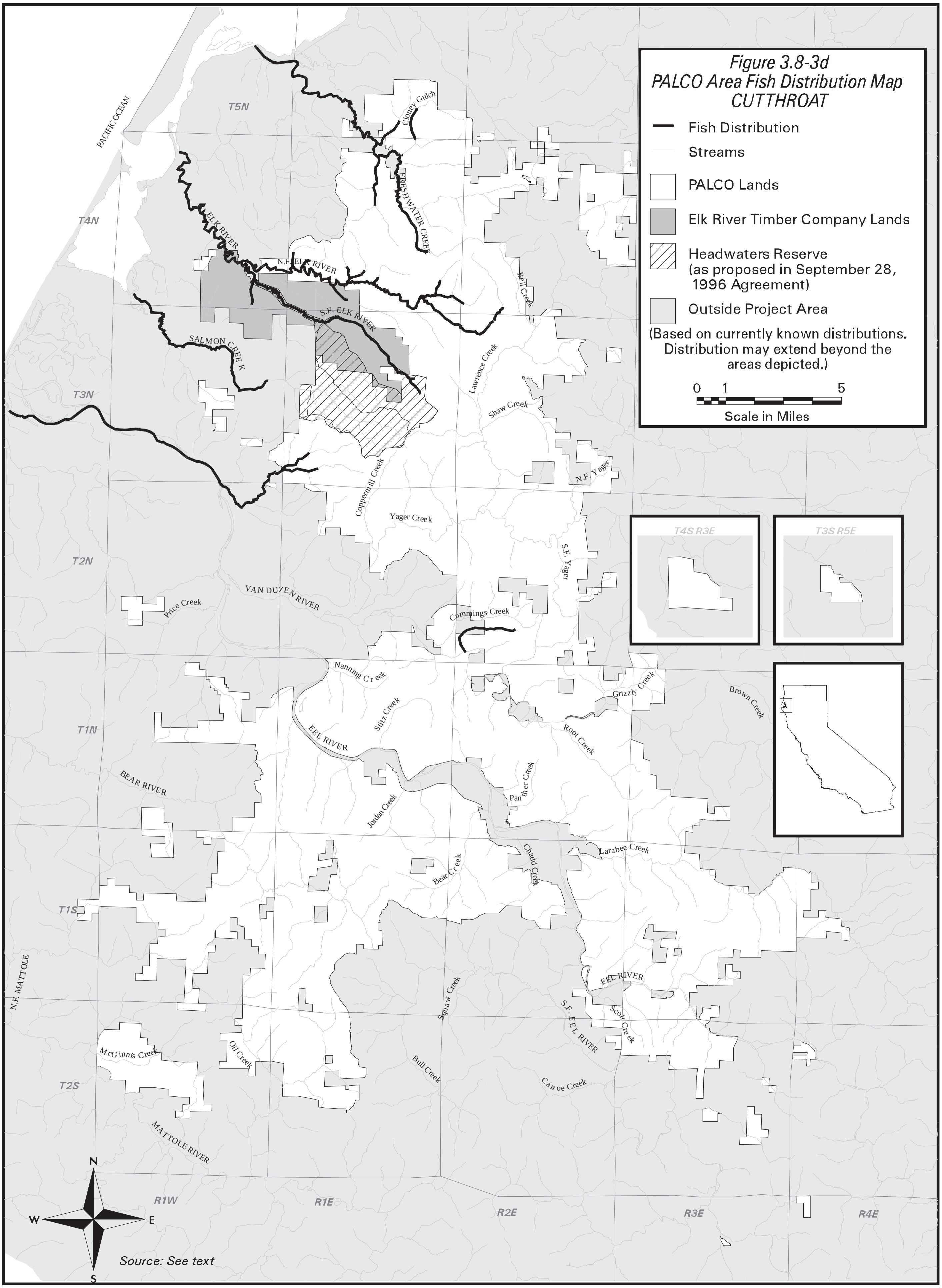


Figure 3.8-3c
PALCO Area Fish Distribution Map
STEELHEAD
Fish Distribution
Streams
PALCO Lands
Elk River Timber Company Lands
Headwaters Reserve (as proposed in September 28, 1996 Agreement)
Outside Project Area
(Based on currently known distributions. Distribution may extend beyond the areas depicted.)
0 1 5
Scale in Miles
T4S R3E
T3S R5E
PACIFIC OCEAN
T5N
T4N
T3N
T2N
T1N
T1S
T2S
R1W
R1E
R2E
R3E
R4E
Cloney Gulch
FRESHWATER CREEK
ELK RIVER
N.F. ELK RIVER
S.F. ELK RIVER
SALMON CREEK
Bell Creek
Lawrence Creek
Shaw Creek
N.F. Yager
Coppermill Creek
Yager Creek
S.F. Yager
VAN DUZEN RIVER
Price Creek
Cummings Creek
Nanning Creek
Grizzly Creek
Brown Creek
Stitz Creek
EEL RIVER
Root Creek
Panther Creek
BEAR RIVER
Jordan Creek
Larabee Creek
Chadd Creek
Bear Creek
N.F. MATTOLE
EEL RIVER
Squaw Creek
S.F. EEL RIVER
Scott Creek
McGinnis Creek
Oil Creek
Bull Creek
Canoe Creek
MATTOLE RIVER
N
W
E
S
Source: See text



/blackcomb2/palco2/amls/ps-fish8x11.aml –January 20, 1999 priority fish species in the five main WAAs that encompass PALCO lands. The figures were based on GIS information from PALCO (1998) that was modified by additional information from CDFG (Personal communication, L. Preston, CDFG [Eureka]; Personal communication, S. Downie, CDFG [Redway, 1997]). The distributions present areas only on PALCO lands and areas downstream. For example, chinook salmon, coho salmon, and steelhead are known to occur in the Mattole River basin, but have not been documented on PALCO lands. It is important to note, however, that many areas (e.g., North Fork Mattole, portions of which are on PALCO lands) have not been surveyed for these species. In those unsurveyed areas, NMFS presumes the presence (of coho salmon) if habitat for them exists. Table 3.8-5 provides the distribution of priority fish species by stream miles for PALCO and Elk River Timber Company lands. These distributions are based on currently known, but limited, information (see Figures 3.8-3a,b,c,d).

Anadromous fish spend at least part of their life in freshwater and part in saltwater. Anadromous salmon and trout lay their eggs in stream gravel. Following incubation, juvenile fish hatched from the eggs emerge from the gravel. Depending on the species of salmon or trout, the amount of time the juveniles spend in freshwater varies (Table 3.8-4). Juvenile fall chinook may migrate downstream to the ocean soon after emergence. In contrast, other species such as coho, steelhead/rainbow trout, and cutthroat trout may spend one to two years in freshwater before migrating to the ocean.

In the ocean, anadromous salmon and trout increase in size and mature. Salmon return to their streams of origin to spawn and die. Steelhead and cutthroat trout follow a similar cycle, except they may survive spawning, return to the ocean, and eventually migrate to freshwater to spawn again. Adult salmon and trout seek deep pools as resting or holding sites during periods of sustained low flow (e.g., summer steelhead may spend several months in freshwater before spawning). They seek the cover provided by the deep pools and the potentially cooler water temperatures that may be found in these pools during the summer (Moyle et al., 1995; Nielsen et al., 1994). During this holding period, the fish are conspicuous, congregate in the pools, and are often unable to leave the pools due to low stream flows. Moyle et al. (1995) has indicated that one of the most immediate threats to adult summer steelhead (and likely any salmon that may rest in these deep pools) is poaching. Both snagging of fish from the bank and spearing by divers have been reported.

Steelhead/rainbow trout and cutthroat trout have resident forms that spend their entire lives in freshwater. Resident forms are generally smaller as adults than anadromous forms. However, juveniles of both forms are essentially indistinguishable, which makes clear identification of the two forms in the field difficult.

Coho Salmon

Coho salmon range from northern Japan along the east coast of Russia to Alaska and south along the west coast of North America to California. Coho salmon are found in major rivers and many streams on PALCO lands (Figure 3.8-3a).

Critical freshwater habitat conditions for juvenile coho (CDFG, 1994; Gregory and Bisson, 1997; Fresh, 1997) include the following:

- Year-round cool, high-quality water (e.g., contaminant-free)
- Abundance of shade
- Cover in the form of large, stable, woody debris and undercut banks
- Unembedded gravel/rubble substrate

Table 3.8-5. Fish Distribution on PALCO Lands (by Stream Miles)

WAA	Hydrologic Unit	Steelhead	Chinook	Coho	Cutthroat[1]	Class 1 Stream Miles
Bear/Mattole River	Bear River	9.0				22.6
	Mattole Delta	3.2				5.0
	NF Mattole River	0.8				5.0
	Upper NF Mattole	6.3	0.1			9.6
Bear/Mattole River Total		19.2	0.1			*42.3*
Eel River	Eel Delta	6.3	0.2	0.1	2.5	12.6
	Giants Ave	0.7	0.2			1.2
	Larabee Creek	12.3	6.0	3.9		21.5
	Lower Eel	15.6	6.7	2.9		30.9
	Sequoia	10.5	4.4	3.6		13.7
Eel River Total		*45.3*	*17.5*	*10.5*	*2.5*	*79.9*
Humboldt Bay	Elk River	13.98	15.49	15.79	17.11	21.5
	Freshwater Creek	11.2	9.9	11.1	7.3	21.8
	Salmon Creek	7.2	7.2	4.7	7.2	0.7
Humboldt Bay Total		25.2	22.2	23.7	24.4	*44.0*
Mad River	Butler Valley	0.0	0.0	0.0	0.0	0.6
	Iaaqua Buttes	0.0	0.0	0.0	0.0	2.9
Mad River Total		0.0	0.0	0.0	0.0	*3.5*
Van Duzen River	Van Duzen WAA	20.8	17.5	13.9	1.9	30.4
Yager Creek	Lawrence Creek	16.9	8.6	6.9		25.6
	Lower Yager	16.6	12.8	6.5		19.6
	Middle Yager	2.5	1.1			7.2
	North Yager	2.9	2.6			3.5
Yager Creek Total		38.8	25.0	13.4		55.9
Grand Total		**156.6**	**84.8**	**66.2**	**36.0**	**256.0**
Elk River to PALCO						
Humboldt Bay	Elk River	3.2	3.2	3.2	3.9	8.0
Humboldt Bay Total		3.2	3.2	3.2	3.9	8.0
Grand Total		**3.2**	**3.2**	**3.2**	**3.9**	**8.0**
HCP Planning Area Total		**159.8**	**88.0**	**69.4**	**39.9**	**264.0**
Headwaters Reserve (not included above)						
PALCO to Reserve						
Humboldt Bay	Elk River	1.0	0.0	0.0	1.1	2.8
	Salmon Creek	0.0	0.0	0.0	0.0	4.2
Elk to Reserve						
Humboldt Bay	Elk River	8.7	7.6	7.6	7.6	9.6
HEADWATERS TOTAL		**9.7**	**7.6**	**7.6**	**8.7**	**16.6**

1/ Limited Cutthroat Data
Source: Foster Wheeler Environmental Corporation

- Enough pool habitat
- Adequate food supply
- Shallow habitat along stream margins for young fish
- Refuges from high water temperature, low stream flows, and natural flooding
- Side channels and other lateral habitats
- Low levels of competition and predation

This habitat is particularly susceptible to human disturbances (CDFG, 1994; Gregory and Bisson, 1997) such as the following:

- Dams or fish passage barriers that prevent upstream access or modify downstream conditions
- Gravel mining that eliminates spawning and rearing habitat and downstream recruitment of spawning gravel
- Agricultural and domestic diversion of stream flows, particularly during the summer months
- Riparian vegetation removal, bank erosion, and sedimentation due to over-grazing
- Agricultural and urban runoff
- Road construction and runoff
- Logging practices

Coho historically occurred in 582 streams along the coast of California (Brown and Moyle, 1991). By 1987, only 132 of 244 streams (for which records exist) had coho runs, while 112 did not. Information on the remainder of the streams was not available (CDFG, 1997a), but the information on the 244 streams demonstrates that the distribution of coho has significantly declined.

In recent years, populations of wild (or naturally spawning) coho salmon along the coasts of Washington, Oregon, and California have declined significantly to levels that may endanger or threaten their further existence (Moyle et al., 1995; Weitkamp et al., 1995). The exact reasons for this decline are unclear, but may be related to ocean conditions, overharvest, stream conditions, land use practices, or a wide variety of other factors. Due to concerns about the decline in coho salmon in California, the commercial fishery has been closed, and the sport fishery is now limited to isolated areas.

In July 1993, the NMFS, under the FESA, was petitioned to list coho salmon in five separate areas along the West Coast and to designate these areas as critical habitat for the recovery of this species [60 FR 38011, July 25, 1995]. The five areas are central California, southern Oregon/northern California, the Oregon Coast, the lower Columbia River/southwest Washington coast, and the Puget Sound/Hood Canal (Figure 3.8-4). In October 1996, coho salmon in the central California area were listed. On April 25, 1997, coho salmon in the southern Oregon/northern California areas were listed as “threatened.” Coho in the Oregon Coast ESU were listed as threatened on August 3, 1998. The other areas are under further review.

Because wild coho salmon are listed in southern Oregon/northern California, the NMFS will develop a draft recovery plan that addresses critical habitat issues, recommends management options, and identifies criteria to evaluate whether recovery efforts are working. The draft recovery plan, which encompasses the entire ESU, will then undergo a major public review process. It may take a year or more before the plan is finalized and implemented.

In addition to the NMFS review, the coho salmon has been identified by the state of

Figure 3.8-4. Proposed West Coast Coho ESUs. This figure is currently being digitized.

California as a candidate species for threatened status throughout its current range of distribution in California.

Chinook Salmon

The chinook salmon has a wide distribution along both the east and west coasts of the North Pacific. Chinook salmon are found in the main streams encompassing PALCO lands, including Freshwater Creek, the Elk River, the Eel River drainage, and the Mattole River (Figure 3.8-3b).

Similar to coho salmon, populations of chinook salmon in some areas of the West Coast have declined severely to levels that have required listing under the FESA. Examples include the winter-run chinook salmon in the Sacramento River (listed as endangered) and chinook salmon in the Snake River, a tributary to the Columbia River (listed as threatened). Nehlsen et al. (1991) considered fall chinook to be at high risk of extinction in the Mattole River and at moderate risk in the lower Eel River. The NMFS was petitioned to list chinook salmon and designate critical habitat in California and other areas of the Pacific Northwest under the FESA. A status review is being completed and will be published in a forthcoming National Oceanic and Atmospheric Administration (NOAA) technical memorandum. However, NMFS has concluded that chinook salmon in the northern California area (north of San Francisco Bay) "are not presently in danger of extinction but are likely to become endangered in the foreseeable future (CFR 30263, June 8, 1995)." Chinook salmon currently are federally proposed as threatened on the southern Oregon and California Coast ESU (63 FR 11482, March 9, 1998).

Steelhead /Rainbow Trout

Steelhead trout, the anadromous form of rainbow trout, ranges from southern California to Alaska (Busby et al., 1996). Steelhead typically spawn from late winter through spring. This species is widely distributed in most streams on PALCO lands (Figure 3.8-3c). Several forms may be found, including summer runs, winter runs, and "half-pounders." Each of these forms has somewhat different life history characteristics (Table 3.8-4).

Because of their extended residence time in freshwater, habitat requirements for juvenile steelhead trout are similar to those of coho salmon. Both require, for example, year-round high quality water, cover, unembedded substrate, and adequate food supplies.

Overall, there is little current information on run sizes of steelhead in the five main WAAs. However, based on available information, Busby et al. (1996) concluded that steelhead trout near PALCO lands are not currently in danger of extinction, but are likely to become endangered in the near future. Summer-run steelhead abundance is, however, considered very low (Busby et al., 1996).

Similar to coho and chinook salmon, steelhead were petitioned for listing under the FESA due to apparent population declines. Steelhead status was reviewed through a formal process to determine if they should be listed. One of the possible areas for listing included the north coast of California (Figure 3.8-5). In March 1998, it was decided not to list this species. The primary reason for not listing the species was that the state of California has proposed a recovery plan intended to conserve and rebuild wild steelhead populations. It remains, however, a federal candidate for listing in the northern ESU (63 FR 13347, March 19, 1998).

Figure 3.8-5. Proposed West Coast Steelhead Areas. This figure is currently being digitized.

Coastal Cutthroat

Coastal cutthroat occur from the Eel River in California north to Seward, Alaska. They prefer small, low-gradient coastal streams and estuarine habitats (Moyle et. al, 1995). They have a life history similar to steelhead trout (Table 3.8-4).

Little information is available about run sizes in the five main WAAs encompassing PALCO lands. Similar to coho salmon, chinook salmon, and steelhead trout, the status of coastal cutthroat trout is under review for potential listing and designation of critical habitat. In August 1996, the coastal cutthroat trout in the Umpqua River in southern Oregon was listed as endangered. Cutthroat in the PALCO planning area is currently a federal candidate species for listing [62 FR 37561, July 14, 1997].

Non Priority Species

Table 3.8-6 presents the general life history characteristics of fish species not designated priority species for evaluation. Other than Pacific lamprey, these species were not included in the HCP under the "List A" species. Less is known about these species in the planning area than the priority species, primarily because they do not support similar fisheries of interest at present. Species such as American shad are not native to the West Coast and California roach have been introduced from other areas in California (Table 3.8-4).

3.8.3 Environmental Effects

3.8.3.1 Criteria for Evaluation

Criteria for determining potential effects of the alternatives on priority fish species and aquatic habitat[1] were based on two broad-scale perspectives:

- Management approaches under each alternative in riparian and upslope areas
- Habitat needs and biological requirements of priority fish species

The aquatic habitat in the planning area is large and complex. It is assumed that current freshwater habitat conditions in this area, in general, do not fully meet requirements for priority fish species (as discussed in Section 3.8). For example, at certain times of the year (e.g., during late summer), water temperatures in some streams (e.g., Eel and Mattole rivers) exceed favorable levels for priority species. This is often associated with lack of streamside vegetation to provide shading. Such shading can reduce the water temperature, but can also be influenced by other factors such as weather conditions, air temperatures, elevations, and groundwater inflow.

Management approaches under each alternative would affect aquatic habitat conditions in a different manner. This assumption, although used in a general sense for the planning area, is not universal. For example, conditions in some areas (e.g., the Headwaters Reserve) may be at or near levels that would support healthy populations of priority fish species; whereas, conditions in water-quality-limited streams (see Section 3.8) may be less able to fully support populations of any priority fish species. Such areas may include the Freshwater Creek watershed (Freshwater Creek HU), Elk River, and Jordan, Bear, and Stitz creeks (Lower Eel HU), which CDF has listed as cumulatively impacted by sediment.

It was also assumed that current aquatic habitat conditions for priority fish species in the proposed HCP planning area might remain the same or become more unfavorable before they would improve under any of the alternatives, primarily

[1] [Note: This section does not consider amphibians. See Section 3.10 for a discussion of those species.]

Table 3.8-6. General Life History Characteristics of Fish Not Designated as Priority Species for Evaluation

Common Name *Scientific Name*	**Distribution Notes**	**General Habitat Requirements**	**Adult Food Habits**	**Reproductive Biology (in CA)**
Pacific lamprey *Lampetra tridentata*	Coastal streams from southern CA to AK	Habitat usually marine, but enter freshwater streams to spawn; spawn in sandy gravel at the upstream edge of riffles.	Adults parasitic on other fish in marine environments	Migrate upstream in late spring and early summer; juveniles remain in fresh water for 5-6 years.
Coastal prickly sculpin *Cottus asper*	Ventura River, CA, north to Seward, AK	Reside in calm waters of rivers and streams; spawning streams have a boulder, cobble and flat rock bottom and slow current	Crustaceans, benthic macroinvertebrates, and occasional fish eggs	Mature 2^{nd}, 3^{rd}, or 4^{th} year; spawn in March-April.
Coastrange sculpin *Cottus aleuticus*	Coastal streams from Morrow Bay, CA, north to AK	Reside in fairly large streams with clean gravels and moderate to rapid currents; migrate to spawning areas with large flat rocks and moderate current.	Aquatic insect larvae and other macroinvertebrates	Usually mature in 3^{rd} year; spawn in spring (March-April peak).
Sacramento sucker *Catostomus occidentalis humboldtianus*	Throughout northern CA	Inhabit a variety of habitats from clear, cold streams to sloughs; spawning runs to upstream riffles where spawn in gravels.	Algae, invertebrate larvae, and small crustaceans on stream bottom	Mature at age 4 or 5; spawn in spring (February to June).
Sacramento squawfish *Ptychocheilus grandis*	Sierra Nevada foothills (e.g., Sacramento-San Joaquin & Russian R.)	Deep, well-shaded pools in larger streams; spawning runs to upstream riffles where spawn in gravels.	Top predator of fish	Mature at age 3 or 4; spawn in spring.
California roach *Lavinia symmetricus*	Sacramento-San Joaquin R. to Russian R. in CA	Small, sometimes intermittent, tributaries; spawn in riffle areas covered with small rocks.	Benthic filamentous algae, crustacea, and aquatic macroinvertebrates	Mature at age 2; spawn in July.
American shad *Alosa sappidisima*	Current West Coast distribution from Todos Santos Bay, Baja, CA to AK	Usually marine, but enter freshwater rivers to spawn; spawning is demersal, so no substrate is preferred.	Planktivorous	Spawning runs occur in March – spawning takes place from April through June.
Green sturgeon *Acipenser mediostris*	Lower Sacramento R., Klamath and Trinity R., Mad and Eel R. in CA	Habitats poorly known – probably similar to white sturgeon, but adults more marine; preferred spawning substrate is large cobble.	Benthic invertebrates, small fish, shrimp, and amphipods	Migrate up Klamath R. from late February to late July; spawn March-July, with a peak from mid-April to mid-June.

Source: PALCO, Preston, Downey, and Vestra, 1998 related to past and potential sediment influxes. The reason for this is the lag time between the continuing effects of past management practices (existing roads) or catastrophic events (the 1964 floods) and anticipated improved conditions in the future following implementation of a specific alternative. For example, recruitment of LWD, which has the potential to improve cover, pool/riffle ratios, and sediment transport conditions, may not be realized for several decades or more (see Sections 3.6 and 3.7) in areas where LWD is currently deficient (e.g., where stream cleaning or timber harvest has decreased LWD recruitment potential). Similarly, regrowth of vegetation to increase canopy cover and shading may require 10 to 15 years to fully improve unfavorable water temperature conditions (see Section 3.7). With this assumption, it is possible that current populations of priority fish species in some or all portions of the affected drainages could continue at low levels or decrease further, perhaps to levels that could not sustain the populations. Therefore, other measures such as supplementation through hatcheries or additional stream improvement might be required as additions to any alternative to conserve and rebuild populations of priority fish species in some streams in a shorter timeframe.

It is impossible to precisely predict aquatic habitat conditions under a specific alternative, particularly if those predictions are for a period that will encompass the 50 years of the proposed HCP. The reason for this difficulty is the complex and dynamic nature of the aquatic system and the surrounding terrestrial environment (flooding, earthquakes, fire, and other major events that affect aquatic and streamside habitat). In the above example on water temperature and streamside vegetation, it is likely that full canopy closure and regrowth of streamside vegetation to the distance of 100 feet will result in lower water temperature during late summer periods than if no vegetation were present. Therefore, where current streamside conditions provide minimal or no shading (see Section 3.7), the regrowth or development (as proposed in the HCP) of vegetation can be predicted, in general, to establish a trend toward lower water temperatures than under current conditions.

The above example must also consider site-specific conditions. A favorable trend toward lower water temperatures may be the case when streamside vegetation regrows on smaller streams. However, on very large streams that have broad stream channels (such as the lower Eel and lower Van Duzen rivers), the effects would be less pronounced because the shading effect of canopy proportionally covers only a very small area (if any) compared to a smaller stream where the canopy may provide a much larger shading effect. Similarly, LWD is likely less stable in a larger stream than in smaller streams because larger channels contain fewer, but often larger, pieces of woody debris due to higher capacity to move larger materials (R2, 1998).

Trends in aquatic habitat changes also involve a time consideration. For example, priority fish species have a relatively short life cycle (up to four years). In WAAs where habitat is degraded, habitat restoration would only begin to become effective after a longer period (greater than 10 years). Therefore, several life cycles of priority fish species may encounter less than desirable habitat conditions before any management measures become effective. However, a reduction in any factor that limits aquatic habitat in the planning area during the short term should establish a trend toward more favorable conditions for maintaining or recovering priority fish species.

When predictions cannot be precisely made, as is the situation when applying any of the alternatives to the planning area, monitoring is often required to determine if a trend toward favorable or target conditions is occurring and the strength of that trend. For example, monitoring of water temperature at various locations over a number of years would provide the information needed to determine if a trend toward lower temperatures (e.g., in late summer) could be correlated with increasing regrowth of streamside vegetation.

The federal and state agencies identified target instream, streamside, and upslope conditions required for reasonably healthy aquatic habitat conditions for priority fish species in the planning area (Appendix K, Properly Functioning Aquatic Habitat Matrix). The conditions are directed at the following:

- Water quality (e.g., water temperature, turbidity, and sediment)
- Habitat access (e.g., physical barriers such as culverts that are impassable for upstream migrating fish)
- Habitat elements (e.g., large woody debris, pool frequency and quality, sediment pool filling and embeddedness, off-channel habitat, and refugia)
- Channel condition and dynamics (e.g., width/depth ratio, streambank conditions, floodplain connectivity)
- Flow and hydrology (e.g., peak and base flows)
- Watershed conditions (e.g., road management, disturbance, and riparian buffers)

These conditions are primarily based on habitat needs for coho salmon. Reasons for focusing on this species are its extended reliance on high-quality freshwater habitat and its recent federal listing under the FESA in southern Oregon/northern California (see Section 3.8.1.5). Therefore, it is assumed that if favorable habitat conditions are provided for coho salmon, then other priority fish species should also benefit. The target conditions are neither all-inclusive, nor do they provide total optimum conditions for maintaining or recovering coho salmon populations. They do not address other factors such as predator-prey interactions, disease, ocean conditions, sport and commercial harvest, or food availability that may also significantly affect survival of coho salmon.

Current aquatic habitat conditions in the planning area may be improved through management practices (i.e., streamside and upslope protections). A properly functioning aquatic habitat is considered that level most advantageous for maintaining or recovering priority fish species (see Appendix K). The target conditions are used to define this level. Management practices that do not establish positive trends toward the target conditions may not provide for maintenance or recovery of priority fish species.

It is unclear if all of the target conditions ever naturally existed in the PALCO HCP planning area, even before land use activities. This uncertainty is particularly evident when considering the naturally high sediment yields in this area (see Section 3.6). However, past management-related impacts probably contribute less than favorable conditions in some areas (higher sediment compared to background levels). These past impacts are discussed in Sections 3.6.1.4, Timber Harvest Practices and 3.7.4.2, Historical Setting for Evaluating the HCP and Alternatives. From the limited information available on aquatic habitat conditions in the PALCO HCP planning area (R2, 1998), it appears that some target conditions currently are not being met. For example, high water temperatures, sedimentation, or turbidity are factors that have resulted in the listing of the Van Duzen, Eel, Mad, and Mattole rivers as water-quality-limited (see Section 3.8.1.3).

Evaluation of the environmental consequences on aquatic resources focused on the strength of the trends that the management conditions would have in achieving target conditions under each alternative. A strong trend in changes leading to attainment of target conditions would indicate that maintaining or restoring priority fish populations is more probable than under weaker trends. Even with conditions meeting requirements for a properly functioning aquatic system, however, there is no certainty that current populations will be maintained or recover.

Thresholds of Significance

The interrelationship of management activities, environmental components or systems, and related thresholds of significance, are discussed in Section 3.1 and illustrated in Figure 3.1-1. Section 3.1 describes the interrelationship of effects among the environmental components and the related thresholds of significance for Sections 3.4, Watersheds, Hydrology, and Floodplains, 3.6, Soils and Geomorphology, 3.7, Wetlands and Riparian Lands, and 3.8, Fish and Aquatic Habitat.

The thresholds of significance for fish and aquatic habitat under an alternative (including the full range of mitigation contained in the alternative) are (1) the potential to threaten individual priority fish species or reduce populations on PALCO ownership and affected areas downstream in the overall context of actions proposed and (2) not providing improving aquatic habitat conditions or a properly functioning aquatic system over the term of the HCP. If timber harvest were allowed to the stream edge on Class I and II streams, for example, fish and aquatic habitat could be adversely affected. Common effects could be increased water temperatures in the summer due to the lack of shading, loss of potential LWD recruitment, embeddedness of the stream substrate, filling of pools with sediment, destabilization of streambanks, and other effects that would produce unfavorable aquatic habitat conditions for priority fish species. Therefore, this management action (harvest to the stream edge) would likely not provide a properly functioning system. However, if effective streamside buffers were implemented, these management practices could be used to offset the adverse effects to a level that would not significantly impact fish or aquatic habitat.

It is impossible to precisely predict specific salmon population numbers for any particular alternative, particularly if those predictions are for a period that will encompass 50 years. It is also impossible to precisely predict other factors (e.g., ocean conditions, predation, disease, harvest, or competition) that may affect these populations. Therefore, the environmental assessment of potential effects has been focused on habitat requirements. If habitat is properly functioning, then other factors need to be assessed to determine why coho salmon and other salmonid species are either depressed or in need of listing.

To achieve a properly functioning aquatic system and to safeguard priority fish species or populations, unlimited or complete protection across a landscape is not needed to maintain conditions below the threshold of significance. Indeed, this level of protection would minimize potential take to such a level that an ITP and HCP would not be necessary. There is a point beyond which, for example, the width of an RMZ would not provide any significant additional levels of protection. For instance, stream buffers greater than about 100 feet with 80 percent canopy closure would not provide additional shade to reduce stream temperature (see Section 3.7). Less than full protection can achieve target conditions because it is the full range of management prescriptions (including for slopes and roads) and the totality of riparian function that must be considered in aggregate. Prescriptions that provide substantial LWD and detritus input, shading, coarse and fine sediment control, and streambank stability, for example, can set a trend toward achieving target conditions and properly functioning aquatic system over the term of an ITP.

Although current conditions that have resulted from past practices may result in the continuation or even potential decrease in existing populations, the measures or prescriptions described in Appendix P are intended to initiate a long-term trend that will conserve and begin to rebuild these populations by providing habitat that meets the requirements for coho salmon and other salmonid species. Therefore, if these conditions, which are based on current understanding of habitat requirements for coho salmon, are achieved (as evaluated through long term monitoring and modified through adaptive management - see Sections 3.8.6 and 3.8.7), "take" will be minimized or avoided.

Because the threshold of significance for fish and aquatic habitat considers the effects of an aggregate of management prescriptions in each alternative, this section relies on the conclusions of several other sections. For example, the amount of LWD that is recruited to a stream is determined by RMZ width and the number of trees prescribed to remain in it (see Section 3.7). Similarly, potential changes in erosion and sediment from upslope areas or from roads also directly affect aquatic habitat conditions (see Sections 3.4 and 3.6). Thresholds of significance or parameters for evaluating effects from riparian and upslope management have been determined or evaluated in Sections 3.4, 3.6, and 3.7.

This section (i.e., Section 3.8) uses these individual determinations and aggregates their overall effects on the aquatic system to determine if an individual alternative provides the likelihood of achieving target conditions (i.e., properly functioning aquatic system) and does not threaten individual priority fish species or fish populations. In addition, the discussion and determination consider the trend that a particular alternative would establish in aquatic conditions if pursued in terms of both the short term (less than 10 years) and the mid to long term (greater than 10 years) or over the 50-year ITP.

If an alternative (with any mitigation measures either included in the HCP or recommended by resource agencies) would result in conditions that are less than significant, then it would be considered to have minimized or fully mitigated any potential negative effects. If implementation of an alternative would improve aquatic habitat conditions for priority fish species over the term of the ITP, for example, it would be considered to have resulted in effects that are less than significant. If, however, an alternative would have the potential to threaten individual priority fish species, reduce populations, or negatively impact aquatic habitat for priority fish species, the effects of the alternative would be considered significant.

For water quantity, the threshold of significance is evaluated by the likelihood of increased scour from peak flows and the likelihood of harvest increasing low flows (Section 3.4). For soils and geomorphology, the threshold of significance is the probability that sediment delivery to streams exceeds water quality objectives or increases stream embeddedness (Section 3.6).

The effects of coarse sediment delivery to streams is evaluated with respect to the likelihood or risk of persistent road-related sediment sources and more catastrophic events such as road-stream crossing failures, road-related landslides, and hillslope mass wasting (Section 3.6). These events can adversely impact fish habitat through channel aggradation, channel morphology changes, and sediment embeddedness.

An alternative must have two characteristics to be less than significant in regards to coarse sediment issues. First, it must have proposed measures that would reduce the risk of sediment delivery to low or moderate (Section 3.6). Second, it must systematically reduce the management-related sediment discharge to streams on an HU-by-HU basis. If the provided measures do not minimize coarse sediment delivery, no improvement in aquatic conditions is possible. Additionally, if measures to reduce sediment are widely distributed over several HUs, they would likely be less effective in providing meaningful reductions in embeddedness and sediment influxes than if measures were focused on one specific HU. Therefore, the measures must be implemented so that an entire HU experiences improvements in sediment influxes or embeddedness rather than being widely distributed within one HU or over several HUs at one time.

As determined in this section, the threshold of significance for riparian zones is the maintenance of the aquatic system through RMZs and the management allowed within them. This threshold involves the key functions including LWD recruitment, leaf and needle litter inputs, stream canopy, streambank stability, and sediment control (Section 3.7). While Section 3.7.4.3 provides information on the level of function provided for all these parameters under the various alternatives, the threshold of significance for these functions is determined in this section. The LWD and sediment EBAI (see Section 3.7) summarize the potential effects that management approaches in riparian zones would have under each alternative.

Finally, some management-related activities are evaluated at a property-wide or landscape level, while others are evaluated on a more localized level. For example, RMZ widths directly affect stream shading and stream temperature. RMZ widths can be implemented property-wide and can be expected to maintain or improve stream temperatures across the entire property starting immediately. Road improvement activities directly influence sediment delivery to streams and embeddedness of the streambed. Road improvement activities are, however, time-consuming, labor intensive, and expensive. They cannot be implemented across the entire 210,000-acre HCP planning area at one time. Consequently, improvements in road conditions are evaluated by the level of improvement that can be expected to occur over several decades and by how much improvement occurs property-wide over the term of the HCP.

3.8.3.2 Alternatives Analysis

Alternative 1 (No Action/No Project)

The state and federal assumptions for assessing environmental impacts to aquatic resources under the No Action alternatives differ due to differences in the analytic approach required by CEQA and NEPA. CEQA implementing regulations require that an EIR discuss "the existing conditions, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved [14 CCR 15126(d)(4)]." CEQA neither requires a projection into the long-term future that could be deemed speculative, nor a quantitative analysis of the No Project alternative for comparison with the other alternatives. Accordingly, the state version of the No Action/No Project alternative analyzed here contemplates only the short term and is based on individual THPs that would be evaluated case-by-case. The CDF version of No Action/No Project alternative does not attempt to forecast how PALCO's entire property would look in 50 years (the length of the proposed ITP). Since how many THPs there would be, where they would lie geographically, and how they would differ in detail are unknown, no quantitative analysis of THPs is presented (see Section 2.5.1).

The likely No Action/No Project alternative would consist of PALCO operating in a manner similar to current THP practices and subject to existing CDF regulatory authority. In reviewing individual THPs, CDF is required to comply with the FPA, FPRs, and CEQA through its certified functional equivalent program (see Section 1.6). The specific criteria for evaluating THPs contained in the FPRs are combined with the case-by-case evaluation of each THP for significant effects on the environment, followed by consideration of alternatives and mitigation measures to substantially lessen those effects. Under CEQA and the FPRs, CDF must not approve a project including a THP as proposed if it would cause a significant effect on the environment and if there is a feasible alternative or feasible mitigation measure available to avoid or mitigate the effect. An adverse effect on a listed threatened or endangered species would be a significant effect under CEQA.

In addition, the present FPRs provide that the Director of CDF shall disapprove a timber harvesting plan as not conforming to the rules if, among other things, the plan would result in either a taking or a finding of jeopardy for fish or a wildlife species listed as rare, threatened, or endangered by the CDFG or a federal fish or wildlife agency, or if it would cause significant, long-term damage to listed species. To make a determination as to the effect of a THP on listed fish or wildlife species, CDF routinely consults with state agencies and notifies federal fish and wildlife agencies. These processes and independent internal review by CDF biologists can result in a THP that contains additional site-specific mitigation measures similar to the ones described in the Proposed Action/Proposed Project. CDF believes that its existing process using the FPRs and the CEQA THP-by-THP review and mitigation are sufficient to avoid take of listed species.

The mitigation by which an individual THP is determined to comply with FPRs the FESA and CESA, and other federal and state laws is determined first by compliance with specific standards in the FPRs and then by development of site-specific mitigation measures in response to significant effects identified in the CEQA functional equivalent environmental analysis of the individual THP. A wide variety of mitigation measures tailored to local conditions is applied with the purpose of avoiding significant environmental effects and take of listed species. These include, but are not limited to, consideration of slope stability, erosion hazard, road and skid trail location, WLPZ width, BMPs on hillslopes and within WLPZs, and wildlife and fish habitat. Consequently, most significant effects of individual THPs can be expected to be mitigated to a level of less than significant through implementation of the No Action/No Project alternative.

In some cases, CDF may determine that it is not feasible to mitigate a significant effect of a THP to a less than significant level. In such a situation, CDF would have to determine whether specific provisions of the FPRs such as not allowing take of a listed threatened or endangered species would prohibit CDF from approving the THP. If approval is not specifically prohibited, CDF would have to weigh a variety of potentially competing public policies in deciding whether to approve the THP. A THP with a significant remaining effect could be approved with a statement of overriding considerations, but such an approval would probably be rare.

As noted in Section 2.5, under NEPA, the degree of analysis devoted to each alternative in the EIS will be substantially similar to that devoted to the Proposed Action/Proposed Project. The federal agencies recognize that a wide variety of potential strategies could be applied that could represent a No Action/No Project scenario and that they would involve consideration of the mitigation measures described above. For the purposes of analysis under NEPA, however, these additional mitigation measures are represented as RMZs, rather than management options developed for site-specific conditions. Consequently, the analysis of the No Action/No Project alternative considers the implementation of wide, no-harvest RMZs as well as restrictions on the harvest of old-growth redwood forest to model conditions over the short and long term. Ranges of RMZ width are considered qualitatively because it is expected that adequate buffer widths could differ as a result of varying conditions on PALCO lands.

Figures 3.7-3 a, b, and c present the RMZ widths and associated prescriptions for all of the alternatives for Class I, II, and III streams, respectively. For Alternative 1, these would be no-harvest buffers. Class I buffers would be 170 to 340 feet on each side of the river from the edge of the CMZ. Class II buffers would be 85 to 170, feet and Class III buffers would be 50 to 100 feet. The Alternative 1 RMZ buffers are more than sufficient to protect riparian and aquatic components (including stream water temperature, stream canopy LWD recruitment, leaf and needle litter production, and sediment filtration) for Class I, II, and III streams, as discussed in Section 3.7.4.3 and shown by the EBAI (Figures 3.6-6, 3.6-7, and 3.7-4).

These RMZ buffer prescriptions provide a high level of confidence that Alternative 1 RMZs would provide positive trends in the associated aquatic components in areas where past management practices have resulted in unfavorable aquatic habitat conditions. Example areas include the Van Duzen, Bear, Lawrence Creek, and lower Eel HUs where approximately 47 percent of the total riparian vegetation is comprised of young, open forest or mid-seral forest. Overall, the effects of implementing the RMZs of Alternative 1 are not likely to result in the take of priority fish species. Therefore, the potential effects of the buffers would be less than significant and favorable for conserving or rebuilding populations of these species in the planning area. In areas where stream-clearing activities have occurred, there would be an extended period of time (up to 100 years or more) for LWD recruitment to naturally attain desirable levels that approach target conditions (see Section 3.7).

The wide RMZs for this alternative coupled with no-harvest restrictions would also protect streambanks in unharvested areas and begin to stabilize them in areas that have been harvested. This would establish a positive trend toward a properly functioning system and target conditions. Bank stabilization would assist in decreasing erosion of streambanks (and associated sediment problems in aquatic habitat such as pool filling and aggradation) and provide potential cover (e.g., undercut banks where juvenile fish can seek resting habitat or refuge from predators). In areas where little or no streamside vegetation currently exists (see Figure 3.8-2a, b, and c), positive effects may not be apparent over the short term, but would begin to be apparent over the longer term (greater than 10 years) as the vegetation begins to become established (see Section 3.7). Appendix Table K-4 provides general projections of seral stages in RMZs for various alternatives for 0, 10, 50, and 120 years. In areas where mid to late seral or old-growth forest are present, the LWD recruitment potential may be adequate to maintain or establish a trend toward properly functioning conditions. Exceptions would be areas where stream-clearing activities have removed LWD or other materials, and no restoration or replacement has occurred.

As vegetation progresses to higher mid- to late-seral stages, a corresponding trend toward properly functioning aquatic habitat conditions should become evident. Significant increases in peak flows are not expected to occur from this alternative (Section 3.4.3.1) and thus, peak flows would continue at levels similar to current conditions or would provide only minor or undetectable increases (see Section 3.7). Quantification of any potential changes in peak or base flows is not possible at this time because specific information to develop such projections is not available.

Harvest-related sediment input to streams would likely be reduced under Alternative 1 because of the wide RMZs. Since some timber harvest mass wasting would continue, however, there is some risk that this could be a potential source of sediment. The absence of management plans for existing roads under this alternative would not protect streams from road-related mass wasting and stream-crossing failures, or road-bed, traffic-related sediment (Section 3.4). This would likely contribute a significant amount of fine and coarse sediment to streams above levels that would allow attainment of target properly functioning aquatic habitat conditions (see Appendix K). Road-related sediment influx directly to streams would persist, especially in HUs with a high number of stream crossings (Table 3.6-3). New roads or roads managed under current FPRs would use better protective mechanisms that avoid these potentially negative effects on aquatic habitat. Any continued input of fine sediment to streams would likely significantly increase the embeddedness in streams and would not allow any improvement in existing conditions. These embeddedness effects would result in an unquantifiable effect on coho salmon and other priority fish species. Overall, the sediment input to the aquatic habitat under Alternative 1 would exceed the threshold of significance. The primary reason is not current practices, but is more directly related to existing roads and areas of mass wasting where treatment would not be generally required.

Turbidity is closely linked to sediment runoff, although turbid waters (with the exception of suspended fine sediments that can be deposited in spawning gravels) can be flushed from a system much more quickly than coarser sediment. Increases in turbidity are expected to occur primarily during the first fall rainstorms of a given year or mass wasting events. Such increases can be due to runoff from existing roads, or slope and road failures. The turbidity increases associated with these sources would have short-term effects on priority fish species and other aquatic life (e.g., aquatic insects and algae) to a level that would be less than significant. These effects could include short-term disruption of feeding behavior and habitat use, as well as providing protection from predators. The duration would likely be only a few days or less. In addition, the wide buffers associated with this alternative would be expected to provide the capacity to filter turbid waters to a level that would avoid or minimize effects on aquatic habitat.

The RMZs are established at the edge of the CMZ. Therefore, for this alternative and all other alternatives, the CMZ is restricted from harvest. (Exceptions to the no-harvest prescription would be (1) to enhance riparian function and (2) for emergency situations. See Section 3.7). In areas where the CMZ is narrow (e.g., an incised canyon), the amount of terrestrial and aquatic habitat is relatively small compared to much wider CMZs that may be found in lowland reaches or areas of less gradient where the CMZ may be wider. As a result of the restricted harvest in the CMZ, floodplains, aquatic habitat connectivity (e.g., side channels to mainstem flow), and backwater areas would be maintained at current levels or would improve as other prescriptions (e.g., RMZs, EEZs, ELZs, and upslope restrictions) begin to become effective.

Any prescribed burning activities would be expected to occur outside of the riparian zone (for all alternatives). This would likely avoid or minimize any effects on aquatic habitat or water quality from this activity. The effects of burning would be essentially the same for all action alternatives. Therefore, they are not discussed further in this EIS/EIR.

PALCO currently has approval for its gravel removal operations in streambeds (PALCO, 1998). This approval includes an incidental take statement issued by the NMFS. In addition, CDFG Code Section 1603 Agreements with CDFG (see Section 1) are required for gravel removal operations in streambeds. These agreements are intended to protect aquatic resources. Gravel mining will prevent some areas of streambed from developing a riparian zone on currently unvegetated gravel bars (see Section 3.4). However, the effects of gravel removal are localized, small in area (see Section 3.4), and will not directly affect salmonid habitat. Consequently, these effects are less than significant.

Effects from grazing by cattle, if maintained at current levels (see Section 3.6), would be expected to be minimal, except in localized areas (see Section 3.6). Therefore, this land use would be expected to have less than significant effects on coho and other priority fish species.

The effects of grazing and gravel mining would be essentially the same for all action alternatives (see Grazing in Sections 3.6 and 3.7). Therefore, the effects of these activities are not addressed further. Both activities may be added to the ITP at a later date, through an amendment process.

In general, the RMZs under Alternative 1 would improve aquatic habitat and set a trend toward achievement of target conditions of a properly functioning system. This would be most apparent in areas of currently disturbed conditions (e.g., in the Van Duzen River HU) where PALCO owns a major portion of the HU (Table 3.4-2). The area encompassed by the RMZs would be approximately 58,811 acres or about 25 percent of the planning area for PALCO. The improvement from these buffers would, however, be offset by the lack of systematic road improvements, particularly for existing roads.

Alternative 2 (Proposed Action/Proposed Project)

Figures 3.7-3 a, b, and c present the RMZ widths and associated prescriptions for all of the alternatives for Class I, II, and III streams, respectively. For Alternative 2, the buffer widths would vary by stream class slope (e.g., greater or less than 50 percent), and other factors. In addition, default prescriptions would be used until modified by watershed analysis. Even though the no-harvest buffer is smaller in Class I and II streams in this alternative compared to Alternative 1, additional prescriptions are used in the remainder of the RMZ to provide additional management prescriptions that mitigate effects (see Section 3.7).

The RMZs under this alternative would be implemented on a property-wide basis. They are sufficient to protect riparian and aquatic components for Class I and II streams for water temperature, stream canopy, leaf and needle litter, and most LWD recruitment (see Sections 3.6 and 3.7).

Class I RMZs would be 170 feet wide and would be divided into two bands. Band 1 (from the stream or CMZ to 100 feet) would be no harvest. Band 2 (from 100 to 170 feet) would provide 240 square feet of tree basal area per acre.

Class II RMZs (see Figure 3.7-3b) would establish a no-harvest buffer of 30 feet on each side of the stream (from the edge of the CMZ). The remainder of the RMZ would range from 100 to 130 feet with a variety of prescriptions (see Section 3.7).

Class III streams (i.e., ephemeral streams with no aquatic life) would have complete harvest to streambank but would be protected by EEZs, ELZs, erosion control measures, and leaving downed trees.

Site-specific watershed analysis and prescriptions could be used to modify the RMZs after the watershed assessment has been reviewed by the FWS and NMFS. Upon completion of the watershed analysis, however, the prescriptions would result in a no-harvest buffer of not less than 30 feet and not more than 170 feet on each side (or from the edge of the CMZ) of each Class I and II stream. The Class II no-harvest prescriptions could be further modified to 10-foot no-harvest by the FWS and NMFS if they determined that it would benefit aquatic habitat or species. In areas where stream-clearing activities have occurred, there would be an extended period of time (100+ years) for LWD recruitment potential to begin to attain desirable levels that approach target conditions (see Section 3.7). As with Alternative 1, areas that currently have old growth (Figure 3.8-2a, b, and c and Table 3.8-7) would be expected to maintain or recover LWD levels more rapidly than areas where younger forests need enough time to develop levels that provide full LWD recruitment potential (see Section 3.7). For example, areas of PALCO land in the Elk River HU have old-growth forest (Figure 3.8-2a, b, and c) and would be anticipated to have adequate LWD levels, unless stream clearing has occurred. In contrast, other areas (e.g, PALCO land in the Iaqua and Butler Valley HUs) have little or no old growth, with the major portion in mid-seral stage. With this vegetation stage, LWD recovery would take much longer.

Based on PALCO's timber harvest projections for the next 10 years (see Section 3.9), the largest proportion of harvest would occur in the Lower Eel, Freshwater Creek, Elk River, Larabee Creek, and Van Duzen HUs. By inference, it is likely that these HUs would also be most affected during this period. Overall, however, on a landscape scale over the 50-year period of the ITP, the prescriptions would result in effects that are less than significant. Thus, over the period of the HCP, a trend toward properly functioning aquatic conditions

Table 3.8-7. Percentage of Stream Miles for Class I and Class II Streams Found in HCP Planning Area by Seral Stage and Estimated Time to Reach Fully Functioning Aquatic Conditions[1/]

	Total Miles in Class					
	Class I	Class II	Overall	Percentage of Grand Total	Aggregate Recovery Period to Reach Fully Functioning Aquatic Conditions—Except LWD	Aggregate Recovery Period to Reach Fully Functioning Aquatic Conditions[2/]
Grassland	1.1	3.9	5.0	0.5	[3/]	[3/]
Open Natural	61.3	26.0	87.3	8.2	[3/]	[3/]
Hardwood	5.7	16.6	22.3	2.1	[3/]	[3/]
Forest Openings	3.6	16.1	19.7	1.9	Functioning now to 80 years	100+ years[4/]
Young Forest	26.1	107.1	133.2	12.6	Functioning now to 70 years	100+ years[4/]
Mid Seral	95.2	349.7	444.9	42.0	Functioning now to 60 years	50 to 100 years[4/]
Late Seral	70.8	215.3	286.1	27.0	Functioning now	Functioning now to 100+ years
Old Growth	16.8	43.5	60.3	5.7	Functioning now	Functioning now
	280.6	778.2	1,058.8 (grand total)	100		

1/ Base on time scales by Gregory and Bisson in Stouder et al., 1997 (see Table 3.7-11).

2/ Aggregate recovery period is based on all factors reaching fully functional aquatic conditions.

3/ Although it is not specifically known if the hardwood, grassland, and open natural categories will progress to old growth, these categories are included in this table for illustrative purposes.

4/ Primary factor is LWD, which requires extended periods (e.g., 100+ years) to return to fully functioning conditions.

Source: Foster Wheeler Environmental Corporation

would be established. In Class III streams (which are intermittent and do not contain aquatic life), less protection is provided for these functions compared to Alternative 1. During summer periods of low flow, however, these streams would likely be dry. Thus, effects on stream temperature during this potentially critical period would not be an issue. Any trees already down before harvest would not be removed in Class III streams because they would be beneficial for retarding movement of sediment downstream.

High protection of leaf and litter would occur along Class I and II streams. Along Class III streams, there is a greater risk of interrupting input of detritus immediately after harvest and until vegetation becomes reestablished.

For sediment filtration, RMZs for Class I streams are sufficient, but would be less effective for Class II and III streams (see sediment EBAI, Figure 3.6-6). Consequently, the RMZs for Class II and III streams could exceed the threshold of significance with respect to sediment filtration. However, with the requirement to use erosion control measures on any disturbed areas within the RMZ greater than 100 square feet (see Section 3.7), these potential effects would be minimized and would be less than significant with respect to aquatic habitat.

Watershed analysis would be an additional approach to identify and avoid or minimize effects from potential source sites (e.g., mass wasting areas and legacy roads) through implementation of site-specific prescriptions. These analyses would be performed on specific HUs in a sequential manner as follows: decade one—Elk River, Freshwater Creek, Lawrence Creek, Yager Creek (including Lower North Fork Middle, and South Fork); decade two—Van Duzen and Middle; and decade three—Larabee/Sequoia, Mattole, Salmon, and Bear River. Also, with this alternative and Alternative 3, provisions for stormproofing roads, restrictions on winter road construction, and requirements for watershed analysis would be supplemented by incorporating the specific procedures for road sediment described in the *Handbook for Forest and Ranch Roads* by Weaver and Hagans (1994). These procedures were used in an investigation of sediment sources of the lower Eel River (Pacific Watershed Associates, 1998). The investigation was used as a basis to begin minimizing existing sediment delivery to streams. Through these various provisions and procedures, sensitive areas would be identified, and specific measures would be analyzed and prescribed for inclusion in THPs.

The winter (November 1 to April 1) road management prescriptions present a high risk to water quality and aquatic habitat and could exceed the threshold of significance for sediment discharge (see Section 3.4). Wet-weather road use and construction could exceed the threshold of significance for sediment-related parameters, specifically turbidity. However, with the implementation of additional agency-proposed mitigation (see Section 3.4), the effects would be reduced below the level of significance.

Significant increases in peak flows or long-term increases in base flows are not expected to occur from the level of harvesting associated with this alternative (Section 3.4). Therefore, no apparent benefits or impacts on priority fish species would be apparent.

Road-related sediment influx directly to streams would persist in the short term (0 to 5 or 10 years), especially in HUs with a high number of stream crossings (Table

3.6-3). However, the overall effect of the road management provisions of the proposed HCP (i.e., the Assessment Plan and the *Handbook for Forest and Ranch Roads* [Weaver et al., 1995] guidelines; see Alternative 2 discussion in Section 3.6) would be a gradual, but systematic and substantial decrease in the amount of sediment from road and stream-crossing failures. At a minimum, this reduction would occur in the same sequence as the watershed analysis (i.e., decade one—Elk River, Freshwater Creek, Lawrence Creek, and Yager Creek; decade two—Van Duzen and Middle Eel HUs; and decade three—Larabee, Sequoia, Mattole, Salmon Creek, and Bear River HUs).

PALCO proposes to combine the road network assessment and stormproofing program with its watershed analysis program. Because PALCO intends to complete the watershed analysis program within the first few years after issuance of an ITP, the assessment may occur in that timeframe. At a minimum, 50 miles per year (500 miles per decade) would be stormproofed. Consequently, treatment of PALCO's road network should occur within about 30 years. This would produce a systematic reduction in coarse sediment influx that would result in significant improvement in priority fish habitat on PALCO's entire property over the long term. In the short term, priority fish habitat may still be in poor condition (e.g., filled pools).

Roadbed stormproofing would also reduce turbidity effects. Implementation of these measures would be as described above. Over the long term, these measures would provide a positive trend toward target conditions. Similar to Alternative 1, increases in turbidity are expected to occur primarily during the first fall rainstorms of a given year, during mass wasting events, due to runoff from existing roads, or from road failures. Though these increases would persist over the term of the HCP, the turbidity increases would have short-term effects on priority fish species that would be less than significant. Any fine sediments, which are a component of turbidity, could negatively affect intragravel conditions for spawning, incubation, and early rearing of priority fish species (Bjornn and Reiser, 1991). However, the combination of roadbed stormproofing and RMZs would result in maintaining or improving existing conditions involving fine sediments.

The property-wide or landscape level decreases in sediment influx to streams would result in decreases in streambed embeddedness, but would not allow substantial improvement over the short term. These embeddedness effects and lack of short-term improvement in LWD recruitment would likely result in unquantifiable but continuing effects on existing priority fish populations that could extend beyond the term of the HCP. As the effects of management practices occur over the longer term (e.g., streamside vegetation regrows, LWD increases, pool/ riffle ratios improve, and streambanks stabilize), the trend toward target aquatic habitat conditions would be positive.

Streambank stability would be improved under this alternative for Class I and II streams, mainly due to the width of the RMZ and the no-harvest zones. Overall, improved bank stability would provide a positive trend in habitat conditions for priority fish species by providing areas for cover and by decreasing streambank erosion. For Class III streams, the ELZs (less than 50 percent slope) or EEZs (greater than or equal to 50 percent slope) would also provide some protection for streambank stability.

Some of PALCO's activities may be subject to Fish and Game Code Section 1603 (see Section 1.7). PALCO's proposed

Section 1603 Agreement covers certain types of these activities and provides avoidance and mitigation for the effects of such activities on fish and wildlife (PALCO, 1998). Activities not covered by PALCO's proposed Section 1603 Agreement would be subject to separate individual Section 1603 Agreements, the terms of which would be negotiated on a case-by-case basis with PALCO; the agreements would not be included in the HCP.

The Headwaters Reserve would provide full protection for aquatic habitat and priority species within the Reserve. No harvest would occur, which should maintain existing riparian conditions that are mostly late seral and old-growth forest types (see Appendix Table K-3). Elk River Timber Company lands that are part of the Reserve are all located in the Elk River HU and are primarily comprised of late seral vegetation. Implementation of no-harvest practices on these lands would, in the long term, maintain or restore them to levels equivalent to an old-growth system. In addition, slope conditions in both these areas are favorable for minimizing sediment or other runoff problems associated with naturally occurring events such as mass wasting (see Section 3.4).

Alternative 2a (No Elk River Property)

In general, this alternative is similar to Alternative 2, including prescriptions for RMZs and road management. The major differences are that the Elk River property would remain under ownership by Elk River Timber Company. Under these conditions, the Elk River property would not be managed as part of the Headwaters Reserve. Instead, it would be managed under the provisions for non-Headwaters Reserve areas of Alternative 2. These provisions would maintain or improve conditions for water quality and temperature, LWD, and streambank stability in this area, much the same as Alternative 1. In the short term (0 to 10 years), sediment could continue to affect streams, since implementation of management provisions of the proposed HCP on roads that are currently a source of sediment (e.g., existing roads) would be gradual, and may extend over 30 years (see Alternative 2). In addition, mass wasting sites would remain a potential source in these areas, thus reducing or preventing a positive trend toward target conditions for these factors. Over the longer term, however, management practices from the HCP should become more effective in establishing a trend toward target properly functioning aquatic habitat conditions. As in Alternative 2, in aggregate, the measures in the proposed HCP would provide a significant positive trend towards improving aquatic conditions and creating a properly functioning aquatic system on PALCO's ownership. With the implementation of these measures, there would be minimal potential of significant adverse effects on any individual priority fish species or population in the Elk River property. Therefore, the potential effects of PALCO's operations on these species would be mitigated to a less than significant level.

Alternative 3 (Property-wide Selective Harvest)

Figure 3.7-3 a, b, and c presents the RMZ widths and associated prescriptions for all of the alternatives for Class I, II, and III streams, respectively. The Headwaters Reserve would be established (i.e., PALCO and Elk River Timber Company land) as in Alternative 2. On PALCO lands, no redwood old growth and residuals or Douglas-fir old growth would be harvested. An additional 600-foot, no-harvest buffer would surround these stands. The only silvicultural prescription allowed would be selective harvest every 20 years with a target of WHR 6. Stream buffers would be based on a site potential tree height of 170 feet. Class I buffers would be 340 feet on each side of a stream, as measured from the CMZ, Class II buffers would be 170 feet, and Class III buffers would be 100 feet. Initially, these would be no-harvest buffers. Similar to Northwest Forest Plan procedures, however, timber harvest could occur after watershed analysis was conducted, and site-specific harvest prescriptions were identified, based on watershed-level and site-specific hillslope, riparian, and stream conditions. For the purposes of modeling within this alternative, no-harvest buffers for Class I streams were 100 feet, Class II streams were 75 feet, and Class III streams were 25 feet (see Section 3.7).

The RMZs under Alternative 3 are sufficient to protect riparian and aquatic components for Class I, II, and III streams, including stream temperature, LWD recruitment potential, leaf and needle production, streambank stability, and sediment filtration, as discussed in Section 3.7 and shown by the EBAI (Figures 3.6-6, 3.6-7, and 3.7-4). These RMZs would provide favorable trends in the associated aquatic components, and the effects of implementing this alternative would be less than significant. This alternative would be expected to have a positive effect on LWD recruitment potential over the long term and would maintain LWD recruitment potential where it is currently sufficient along all stream classes. Leaf and needle litter would be maintained or increased, reaching levels near Alternative 1 where full protection is provided. Much of the increase over Alternative 2 would be provided by the wider no-harvest RMZs on Class I and III streams. The wider RMZs would also maintain sediment filtering capacity and support streambank stability (see Section 3.7). All of these conditions would be expected to provide a positive trend toward target conditions.

Significant increases to peak flows and base flows are not expected to occur from the level of harvesting associated with this alternative (Section 3.4). Therefore, no apparent benefits or impacts on priority fish species would be apparent.

Road-related sediment influx directly to streams would persist, especially in HUs with a high number of stream crossings (Table 3.6-3). The provisions for stormproofing road stream crossings and road armoring under this alternative would reduce sediment influx to streams from road related mass wasting and stream crossing failures and from road bed traffic related sediment (Section 3.4). These improvements would be provided on an HU-by-HU basis with four HUs being addressed in decades one and two, and three HUs per decade in decades three, four, and five of the HCP. Consequently, specific HUs would experience a significant improvement for priority fish species through reduction in streambed embeddedness in a concentrated time. Also, there would be significant improvement in habitat for priority fish species with respect to sediment (e.g., improvements in pool and gravel quality). These embeddedness effects would result in an unquantifiable, but long-term, trend that reflects improvement toward target aquatic habitat conditions. Also under this alternative (similar to Alternative 2), provisions for stormproofing roads, coupled with watershed analysis, would be supplemented by incorporation of procedures for road sediment reduction (Weaver et al., 1994).

Reductions in turbidity by implementation of roadbed armoring measures and watershed analysis would likely reduce the effects of turbidity on priority fish species. Any increases in turbidity would be expected to occur only during the first fall rainstorms of a given year, during mass wasting events, due to runoff from existing roads, or from road failures. Though these increases in turbidity could persist over the term of the HCP, they would have short-term effects on priority species that would be less than significant.

To the extent roadbed armoring or stormproofing might substantially change the bed channel or bank of any river or stream, a Section 1603 Agreement would be required to protect fish and wildlife resources that could be substantially adversely affected by construction or operation activities.

The Headwaters Reserve (including both PALCO and Elk River Timber Company lands) created under this alternative would be the same as for Alternative 2. In addition, all redwood old growth and residuals and Douglas-fir, old-growth stands in the planning area would not be harvested. These stands would have a 600-foot, no-harvest buffer surrounding them. Taken in total, these areas would provide additional protection for riparian and upslope conditions that would be greater than levels provided by either Alternative 1 or 2.

In general, the RMZs under Alternative 3 would provide a strong trend toward improving aquatic habitat conditions and achieving target conditions. The incorporation of road improvements and mass wasting prescriptions would likely result in positive improvements in specific HUs.

Additional measures could also be incorporated into THPs to provide further protection for priority fish species after watershed analysis was conducted and site-specific harvest prescriptions were identified. These prescriptions would be based on watershed-level and site-specific hillslope, riparian, and stream conditions.

Overall, Alternative 3 would be sufficient to provide a significant positive trend toward target conditions for priority fish species in the planning area. With the implementation of the measures under this alternative, there would be minimal potential to threaten any individual priority fish species or population under PALCO's ownership. In addition, the potential effects of PALCO's operations on these species would be fully mitigated. In conclusion, the implementation of this alternative would be less than significant and would be beneficial with respect to priority fish species and aquatic habitat.

Alternative 4 (63,000-acre No-harvest Public Reserve)

Alternative 4 would provide essentially the same levels of protection for aquatic and riparian functions as Alternative 2 on PALCO's property. However, the much larger 63,000-acre Reserve would provide additional protection compared to Alternative 2, particularly if upslope conditions are improved over existing conditions. Outside the 63,000-acre Reserve, management practices (including additional measures to reduce the risk of potential adverse effects that were added to Alternative 2 [see Appendix P] as a result of the public review and comment process) of the proposed HCP would apply, and the effects would be the same as for Alternative 2 in these areas.

Alternative 4 has a greater number of no-harvest RMZ lands than Alternative 2. However, there is less protection of RMZs provided by the Reserve in this alternative than in Alternative 3. Alternative 3 gains more protection from the wider no-harvest buffers' proposed implementation of a 600-foot buffer around the residual and old-growth areas than the 63,000-acre Reserve under Alternative 4 (see Figure 3.7-5). With no harvest in the 63,000-acre Reserve, current upslope conditions should be stabilized and improved. Similarly, riparian functions should be improved.

Combined, these would provide a positive trend toward target conditions. With the implementation of the measures under this alternative, there would be minimal potential to threaten any individual fish species or population under PALCO's ownership. In addition, the potential effects of PALCO's operations on these species would be fully mitigated. Implementation of this alternative would be less than significant and would be beneficial with respect to priority fish species and aquatic habitat.

Summary of Alternatives for Priority Fish Species

Table 3.8-8 presents the general response trends in aquatic habitat likely to be established (by source) for each alternative. In general, Alternative 2 would provide conditions that trend in a positive direction toward all target aquatic habitat conditions. This would apply to both the riparian and upslope/mass wasting or road system inputs to aquatic habitat. Short-term trends would likely not provide apparent detectable improvements in aquatic habitat. For example, existing roads and mass wasting could continue to affect the habitat while the road improvement program is implemented. In the long term, however, protection of RMZs would stabilize streamside areas, and reductions in coarse sediment from hillslope and road-related mass wasting would stabilize the upslope areas. In addition, measures derived from watershed analysis would address site-specific issues (e.g., specific soil or mass wasting conditions). Over time, as streambanks stabilize, LWD recruitment increases, and water temperatures improve, conditions for priority fish species ("List A" species in the HCP/SYP) should improve.

It is also likely that factors limiting Pacific lamprey abundance and distribution are similar to those that limit anadromous fish, especially suitable water temperature and habitat. Properly functioning conditions for anadromous fish should also provide key habitat features for Pacific lamprey, especially if riparian and instream processes and functions are maintained or restored. For example, LWD in streams increases hydraulic roughness that is related to increased complexity of sediments, thus providing a variety of habitat types necessary to support aquatic species (Buffington, 1995).

Alternatives 3 and 4 would provide very positive significant trends toward the target conditions, primarily because of the additional management prescriptions that would provide more certainty for stabilization of the habitat and a broader application of protective measures (e.g., selective harvest and the high level of protection provided through no harvest of MMCAs and 600-foot buffers for Alternative 3 and a larger reserve for Alternative 4).

Alternative 1 would provide a very positive trend toward target conditions if only the riparian management prescriptions are considered. For example, a high rating of (++) for water temperature was assigned to Alternative 1 due to the large no-harvest buffers (as compared to the [+] for Alternative 2, where large buffers would be present, but the no-harvest zones are smaller). Therefore, the certainty of reaching properly functioning aquatic habitat conditions as a result of riparian conditions is higher in Alternative 1 than Alternative 2. However, Alternative 1 does not provide the level of protection for road-related mass wasting. Therefore, it has an overall potential to provide either neutral or potentially negative trends away from target aquatic habitat

Table 3.8-8. General Response Trends in Aquatic Habitat Likely Established (by source) for Each Alternative[1/]

		No Action	HCP and Option 2a	Property-Wide Selective Harvest	60,000 Acre Reserve & HCP
Aquatic Habitat Condition	**Source Zone**	**Alternative 1 No Action**	**Alternative 2 & 2a HCP**	**Alternative 3 Selective Harvest**	**Alternative 4 63,000-acre Reserve**
Stream Temperature	Riparian Areas	[++]	[+]	[+]	[+]
	Upslope/Road Systems	N/A	N/A	N/A	N/A
Turbidity/Fine Sediment	Riparian Areas	[++]	[+]	[++]	[+]
	Upslope/Road Systems	[-]	[+]	[+]	[+]
Coarse Sediment	Riparian Areas	[++]	[+]	[++]	[+]
	Upslope/Road Systems	[-]	[+]	[+]	[+]
Stream Flow	Riparian Areas	[++]	[+]	[++]	[+]
	Upslope/Road Systems	0	[+]	N/A	N/A
Habitat Complexity	Riparian Areas	[++]	[+]	[++]	[+]
	Upslope/Road Systems	N/A	N/A	N/A	N/A
Food Availability	Riparian Areas	[++]	[+]	[++]	[+]
	Upslope/Road Systems	N/A	N/A	N/A	N/A
Channel Stability	Riparian Areas	[++]	[+]	[++]	[+]
	Upslope/Road Systems	[-]	[+]	[+]	[+]
Water Quality	Riparian Areas	[++]	[+]	[++]	[+]
	Upslope/Road Systems	[-]	[+]	[+]	[+]

1/ Based on prescriptions for the respective alternative.

[++] = Potentially very significant positive trend toward "target" aquatic habitat conditions

[+] = Potentially significant positive trend; likely sufficient to achieve [++] but with less certainty

[-] = Potential significant negative trend or movement away from "target" aquatic habitat conditions

0 = No significant change over existing conditions likely

N/A = Potential significance unclear

Source: Foster Wheeler Environmental Corporation

conditions. The major factors that could continue to remain the same or deteriorate would be from mass wasting of existing roads that cause fine and coarse sediment inputs to the stream system.

3.8.4 Cumulative Effects

3.8.4.1 PALCO HCP Planning Area

Cumulative effects of all alternatives over the term of the HCP are considered to provide beneficial effects for priority fish species by establishing trends toward a properly functioning system. As indicated in Table 3.8-8, Alternative 3 would, in general, provide the most benefits to priority fish species followed by Alternative 4, Alternatives 2 and 2a, and Alternative 1.

Cumulative effects of all alternatives on fish resources and aquatic habitat over the term of the HCP are considered at four levels:

- Within the southern Oregon and northern California ESU for coho salmon (Figure 3.8-4).
- Within the PALCO HCP Planning Area
- Within specific HUs
- Within Headwaters Forest

The following focuses on coho salmon; however, cumulative impacts for coho salmon and other priority fish species within these areas would likely be similar (see Section 3.8.1.5).

Southern Oregon/Northern California ESU

The northern California/southern Oregon ESU reaches from Punta Gorda in California to Cape Blanco in Oregon (approximately 180 miles) and inland approximately 120 miles (Figure 3.8-4), including large river systems such as the Rogue and Smith rivers. According to Weitkamp et al. (1995) in the review on the status of coho salmon, all stocks in this ESU (Figure 3.8-6) are depressed relative to past abundance. However, there are limited data to assess population numbers or trends. Recent estimated numbers of adult spawners in this ESU are 10,000 natural and 20,000 hatchery-produced fish. These mainly originate in the Rogue and Klamath river basins, which are outside the PALCO HCP planning area. Overall numbers in the ESU are considered to be substantially below historic levels, with an estimated 36 percent of streams that no longer have coho salmon spawning runs (Weitkamp et. al, 1995).

In the 1940s, the estimated abundance of coho salmon in this ESU ranged from 150,000 to 400,000 naturally spawning fish [Federal Register, May 6, 1997]. Populations in the California portion of the ESU are estimated at about six percent of the 1940s levels (CDFG, 1994). In addition, in the northern California portion of the ESU, recent data indicate that the proportion of streams with coho salmon present is 52 percent of historic levels (West Coast Coho Salmon Biological Review Team, 1997).

Measures included in the alternatives would, for the most part, only affect the PALCO HCP planning area stream habitat. Due to the strong homing instinct of anadromous salmon and trout to return to their stream of origin to spawn, benefits would be confined to those streams. Thus, if the management approaches in any of the alternatives resulted in a major improvement of freshwater habitat and total production of priority fish species in the PALCO HCP planning area, the benefits would not extend to other streams in the ESU. Straying of adult anadromous fish does occur in some instances (Independent Scientific Group, 1996); however, the low levels anticipated would provide only minimal redistribution to non-HCP planning area streams. Therefore, any increased populations of coho or other priority fish species in the planning area would not be expected to improve populations (at least in the short term) in distant watersheds in the remainder of the ESU. Overall, the coho salmon population of the ESU could benefit.

Approximately 53 percent of the land ownership in the ESU is comprised of federal lands that are primarily managed by the USFS, BLM, and National Park Service. Approximately 46 percent is in private ownership. Therefore, over half of the land in this ESU is regulated under federal rules or policies designed to protect aquatic systems. The remaining ownership in the ESU is either state or local lands [Federal Register, May 6, 1997].

All BLM and USFS lands in the ESU currently receive timber harvest management prescriptions under the Northwest Forest Plan. One of the primary goals of the Northwest Forest Plan is to restore currently degraded habitats and maintain the ecological health of watersheds and aquatic ecosystems, including salmon habitat conservation (USFS and BLM, 1994). Under the Northwest Forest Plan, prescriptions that affect aquatic resources and the streamside or upslope activities that affect those resources are the same or more restrictive than those in Alternative 1.

The Northwest Forest Plan covers a large area in northern California. As indicated in the Federal Register (May 6, 1997), however, the effectiveness of the Northwest Forest Plan in this area is limited by several factors: (1) federal land ownership is not uniformly distributed in watersheds. For example, most of the federal lands are distributed at higher elevations and further inland (with the exception of Humboldt Redwoods State and National Parks) than private land ownerships, which tend to be at lower elevations and more coastal. Thus, protections provided for salmonids on federal lands will not be sufficient to conserve the species, and (2) in other areas, particularly BLM lands, federal lands are distributed in a checkerboard fashion, resulting in fragmented landscapes. These factors combined limit the ability of the Northwest Forest Plan to fully achieve its aquatic habitat restoration objectives at a watershed or river basin scale [Federal Register, May 6, 1997].

The Northwest Forest Plan was implemented relatively recently (it became effective in April 1994). Therefore, the effects of this plan in improving habitat conditions will likely become evident over the next few decades and into the future [Federal Register, May 6, 1997]. On National Park lands, essentially no timber harvest occurs, and streamside and upslope activities that would affect aquatic habitat are extremely limited.

On private and state lands, the FWS and NMFS are working with landowners to develop multiple species HCPs. At the time of listing for coho salmon, there were at least eight industrial timber landowners developing HCPs in northern California (see Section 3.2). These HCPs covered approximately 1.2 million acres [Federal Register, May 6, 1997]. The PALCO HCP is one of those HCPs. Also, numerous other programs and restrictions are designed to protect and improve aquatic habitat on non-federal lands. These were described in the listing notice for coho salmon [Federal Register, May 6, 1997], and the reader is referred to that listing for full details of these plans.

In addition to the HCPs, there are approximately 107,000 acres affected by

THPs and an additional 37,000 acres of nonindustrial timber management plans that are either ongoing or recently completed in Humboldt County (since 1993). By WAA, the following approximate acreages of THPs are either ongoing or recently completed in the Bear-Mattole WAA (17,000 acres), the Eel River WAA (107,000 acres), the Humboldt WAA (48,000 acres), the Van Duzen WAA (18,000 acres), and the Yager WAA (35,000 acres) These values include PALCO operations. The prescriptions included in the THPs outside PALCO lands and the HCPs for landowners other than PALCO establish aquatic habitat protections that would provide benefits to priority fish species in the ESU that would be in addition to the HCP proposed for PALCO lands.

PALCO lands provide important potential coho habitat. The PALCO HCP will contribute to the other efforts to maintain and restore coho salmon on public and private lands in the ESU. Information to determine the actual contribution to the ESU is not available. For example, information on current population levels, habitat conditions, and other factors limiting production (e.g., drought, other land uses, and ocean survival predation) are either unavailable or extremely limited. Therefore, estimating reliable specific trends of population levels in the HCP planning area is not possible. The effects of the HCP, however, will be confined to those stream systems within the proposed HCP planning area and areas downstream, but will not have appreciable effects on other streams in the ESU.

Within PALCO HCP Planning Area

The PALCO HCP planning area affects about 200,000 acres and approximately 1,500 miles of stream within the five main WAAs. Estimates of the number of coho salmon in the PALCO HCP planning area are not available because of the lack of consistent assessments of adult spawners. However, some observations provide a general idea of numbers historically present. For example, the South Fork Eel River is reported as probably supporting the largest remaining natural spawning population in California (CDFG, 1994). In the 1989 to 1990 spawning season, less than 300 adult coho salmon spawners were counted in the South Fork, which is believed to represent a maximum population estimate of about 1,320 adults (CDFG, 1994). Numbers at a counting station (from 1938 to 1975) at the Benbow Dam on the South Fork ranged from over 25,000 in 1947 to about 14,000 in 1963, to 4,000 in 1973, to 500 in 1975. Similarly, adult coho salmon in the Mattole River number less than 800 fish annually, a number much reduced from historic levels (CDFG, 1994). Recent observations in tributaries of the Van Duzen River found only a few (less than four) adults in any one year.

Adult spawners in Freshwater Creek were estimated at 454 fish from 1986 to 1987 and 834 fish from 1987 to 1988. These may be supported by hatchery populations (Brown et al., 1994). In the North Fork Elk River during the 1990 to 1991 season, 48 live adults and three skeletons were observed; during the 1991 to 1992 season, 39 live adults and three carcasses were observed; and in 1992 to 1993, 20 live adults, 12 carcasses, and 18 skeletons were observed. In the South Fork Elk River, 20 live adults, 9 carcasses, and 4 skeletons were observed from 1990 to 1991, and 14 live adults, 6 carcasses, and 4 skeletons were observed from 1991 to 1992 (CDFG, 1994). Brown et al. (1994) estimated that Elk River supports a run of about 400 native coho salmon. Although exact numbers on existing coho populations are not available from Freshwater Creek or Elk River, the recently reported numbers would indicate that these areas may currently have viable populations.

Returns in recent years, however, could be affected by a general coastwide decline and also due to the cessation of operation of PALCO's hatchery releases in 1994 (Personal communication, J. Barrett, PALCO [Scotia]).

Overall, the general trend is for fewer coho salmon in most streams in the proposed HCP planning area, with some streams that may be maintaining or increasing populations (e.g., Freshwater Creek or Elk River). Sport and commercial fishing restrictions ranging from severe curtailment to complete closures in recent years may be providing an increase in numbers of adult spawners in some streams, but trends cannot be established from the existing data. Future closures and restrictions on take under the FESA listing will likely assist in increasing the numbers of adult spawners.

With sedimentation and water temperature being two critical habitat limitations in the proposed HCP planning area (particularly in areas that have been listed as water quality limited under Section 303 (d) of the Clean Water Act, see Section 3.8.1.3 and Table 3.4-4), any of the proposed alternatives would provide additional levels of habitat maintenance or improvement above existing conditions. Therefore, the implementation of any of the management approaches in the alternatives would be expected to provide positive cumulative effects in establishing trends toward target conditions that meet habitat needs and biological requirements for priority fish species. As described in Section 3.8.3.2, however, efforts for some management approaches (e.g., road maintenance or mass wasting prescriptions under Alternative 1) may be insufficient in providing any significant improvement or trend toward target conditions.

Within Specific Hydrologic Units

In general, it would be expected that the higher the proportion of PALCO ownership within a specific HU, the greater the potential effect an alternative would have on the aquatic habitat within that HU by the end of the HCP period. Table 3.4-2 provides the proportions of land ownership by PALCO in the HCP planning area. In general, the HUs where the alternatives would have a major effect include Freshwater Creek (56 percent ownership), Lawrence Creek (55 percent), Upper North Fork Mattole River (50 percent), Elk River (50 percent), and Van Duzen (45 percent) HUs. The Lower Eel (82 percent), however, is somewhat anomalous because the ownership pattern does not include inputs on the mainstem from upstream areas. However, inflows from major downstream areas are also important (e.g., Yager Creek, Van Duzen River, and Lawrence Creek). Therefore, for the Lower Eel HU, the largest effects may be realized on the tributaries rather than the mainstem.

Intermediate effects would likely occur on the North Yager (37 percent), South Yager (33 percent), Larabee Creek (27 percent), Salmon Creek (29 percent), Bear River (25 percent), and North Fork Mattole River (23 percent) HUs. Implementation of any of the alternatives on small or isolated areas of PALCO ownership such as those in the Giants Avenue and the southern Sequoia HUs would likely not result in perceptible effects on these respective HUs.

All of the alternatives have the potential to provide significant maintenance or improvements in aquatic habitat conditions in specific HUs, particularly where PALCO is a major land owner. These lands have been dedicated to timber harvest as the prime land use for many years. Therefore, changes in the management approaches to this harvest that establish a trend toward target conditions of a properly functioning aquatic system will directly affect aquatic habitat. The best opportunities for maintaining or improving aquatic habitat occur in the Lower Eel (particularly tributaries), Freshwater Creek, Lawrence Creek, upper North Fork Mattole, Elk River, and Van Duzen HUs due to the high proportion of land ownership in these HUs that would be affected by any of the alternatives.

Headwaters Reserve

It is likely that the designation of the Headwaters Reserve would maintain existing terrestrial and aquatic habitat which should provide properly functioning conditions for this area. The actual lengths of either Class I, II, or III streams in the proposed Reserve (Alternatives 2, 2a, and 3), however, are small (e.g., about 17 miles of Class I streams that would be included in the Headwaters Reserve and any Elk River Timber Company lands that would be included in the Reserve (see Table 3.8-1). Therefore, the cumulative effect of any of the reserves (Alternatives 2, 2a, 3, or 4) on any priority species would be small relative to any larger land designations (e.g., PALCO lands or the Northern California/Southern Oregon ESU). It is important to note, however, that even if areas are small, they can be useful as refugia for maintaining populations until other areas are restored to properly functioning aquatic habitat.

The rate of change in the trends toward target aquatic habitat conditions would be more apparent in the non-Reserve areas. Therefore, management prescriptions under the proposed HCP would be expected to have more cumulative effects on improving existing conditions on these areas than the Reserve, because the Reserve is likely near optimum at present.

The 63,000-acre Reserve under Alternative 4 would provide additional and more extensive miles of stream than the reserve designated under Alternative 2. As with the other alternatives, the 63,000-acre Reserve would be small relative to the overall northern California/southern Oregon ESU. However, as previously indicated, this area can function as important refugia for coho populations until other areas reach properly functioning aquatic habitat conditions.

Based on public comments and FESA and CESA issuance criteria, the wildlife agencies consider the following additional mitigation to be appropriate to reduce the risk of potential adverse cumulative effects. Details of this additional mitigation are presented in Appendix P. The additional mitigations are intended to reduce the management related cumulative effects on watershed processes, such as the hydrologic system, riparian system, upslope system, and aquatic habitat. The synergistic effects of land management activities on watershed processes are displayed in Figure 3.1-1.

3.8.5 Mitigation

3.8.5.1 PALCO HCP Planning Area

Prescriptions and management approaches described in the proposed HCP and the proposed Section 1603 Agreement are considered mitigation above existing conditions because they are designed to maintain or improve conditions or activities in the future that may impact the aquatic system. Priority measures include, for example, increased road maintenance and repair, established buffer systems, increased LWD potential, and modified logging practices to decrease potential negative effects. These measures are all designed to stabilize upslope and riparian conditions. This should result in an improvement of existing water quality (e.g., temperature and sediment) conditions in currently degraded areas and maintenance of favorable conditions in areas that are not degraded.

PALCO has committed to continuation of a hatchery program with specific guidelines for minimizing potential negative effects (e.g., genetic implications and competition between hatchery-reared and wild stocks). Although this proposal is included in the Draft HCP, it would not be included in the ITP. Instead, any hatchery program would be evaluated in a separate process under Section 10(a)1(A) of the FESA. In addition, the future of the hatchery will be included as part of the assessment of state hatcheries and hatchery program.

The need to decrease potential sedimentation and erosion problems is addressed in the HCP through prescriptions such as increased RMZ widths, road armoring, and improvements in culverts. HCP-consistent erosion and sedimentation control measures for road systems and other logging activities where surface disturbance may occur will be incorporated into THPs. For those alternatives where watershed analysis is incorporated (e.g., Alternatives 2, 2a, and 4), information from these analyses will be used to provide more site-specific data and mitigation measures for the THPs.

Enforcement of regulations should be increased to reduce or prevent poaching of adult salmon or steelhead that are isolated in deep pools or elsewhere during low flow periods. The loss of individual fish that have nearly completed their life cycle and are nearing maturation is particularly damaging to a run of fish compared to the loss of an individual juvenile fish. On PALCO lands, exclusion of the public may be useful for limiting access to critical habitat (such as during low-flow periods when adult fish are highly vulnerable to poaching). On Reserve lands, similar enforcement by the appropriate authorities should be used to protect critical periods in the life cycle of priority fish species.

In the Draft HCP, the applicant provided suggested minimization and mitigation measures that have been analyzed in the Draft EIS/EIR and, for CEQA purposes, in the Final EIS/EIR as resulting in less than significant effects to affected resources except with respect to wet-weather road use and winter road construction and reconstruction activities. However, after reviewing and evaluating public comments on the Draft EIS/EIR in light of FESA and CESA permit issuance criteria, the wildlife agencies have determined that additional measures are appropriate to minimize and fully mitigate the impacts of take and to further reduce potential adverse effects. The complete package of minimization and mitigation measures is presented in the proposed HCP's Operating Conservation Program in Appendix P. Key additional mitigation would include the following:

1. Require RMZs along Class III streams. These RMZs would be 30 feet wide on each side of the stream and would consist of an inner 10-foot-wide, no-harvest zone and then a 20-foot-wide, partial-cut zone where one-third of the volume could be removed. Beyond these zones, there would also be sediment filtration zones whose width would increase with slope steepness. This additional mitigation would provide the following protection: reduce the delivery of any fine sediment from overland flow near these streams; maintain more LWD in Class III streams to reduce sediment transport and minimize the potential for gullying in these channels; and reduce the risk of mass wasting and the associated delivery of both coarse

and fine sediment to downstream Class I and II streams.

2. Implement additional review procedures for new or reconstructed roads in mass wasting areas of concern prior to watershed analysis.

3. Set the cumulative effect/disturbance index at 20 percent, calculated on an HU scale, with restrictions on operations when the index is at or above 20 percent.

Additionally, components of several road management strategies were combined, including the January 7, 1998, guidelines (Appendix E in the Draft EIS/EIR), measures recommended by Weaver and Hagans (1994), and new mitigation proposed by the agencies (see Appendix P in this EIS/EIR). The additional mitigation includes the following:

1. Complete stormproofing within 20 years rather than 30 years as proposed in the Draft EIS/EIR.

2. Summarize and add supplemental prescriptions for winter road construction and reconstruction mitigation.

3.8.6 Monitoring

The HCP proposes a monitoring plan to assess the long-term implications of the HCP. Also, see Section 2.9. The plan emphasizes evaluation of physical, water quality, and biological conditions. Physical conditions include monitoring stream channel characteristics (e.g., width, depth, habitat types such as pools/riffles, percent fines, sediment size, and LWD recruitment). Water quality parameters emphasize monitoring water temperature at multiple sites by using continuous recorders. Biological conditions include evaluation of non-fish species (aquatic insects) as indicators of stream water quality and productivity. Additional studies would be conducted to determine the population numbers of salmon and trout species.

The monitoring would focus on the aquatic habitat needs and biological requirements developed by the federal and state resource agencies (see Appendix K, Properly Functioning Aquatic Habitat Matrix). The HCP has also proposed specific schedules for monitoring. Although the HCP proposes a monitoring plan, specific procedures for monitoring have been discussed throughout the HCP planning process and will be further defined in future negotiations between the resource agencies and PALCO.

Specific results cannot be determined until monitoring has taken place. To provide an ongoing evaluation of monitoring results, the HCP also proposes to use adaptive management to modify HCP conditions as needed to improve aquatic habitat conditions. Adaptive management is a feedback mechanism where information from monitoring or other sources (e.g., studies in other watersheds) is evaluated and used to change management approaches and prescriptions on an ongoing basis. For example, if prescriptions for recruitment potential of LWD do not meet target conditions of a properly functioning aquatic system as anticipated, additional measures to enhance the progress toward achieving these levels would be discussed and existing prescriptions changed, as appropriate.

The main ingredient for success of the adaptive management approach is a strong commitment to continue the process on a scheduled basis (e.g., the term of the HCP is 50 years, and any adaptive management will require adjusting to new conditions and project participants) and with a common intent among the participants to achieve an agreed-upon level of aquatic habitat conditions.

The monitoring plan and the adaptive management approach proposed in the HCP, combined with existing information on aquatic habitats collected by PALCO (1998) and Byrne (1996) in recent years, is important for establishing baseline conditions and evaluating future trends. This approach offers a reasonable plan for monitoring the potential effects of the HCP. The adaptive management inherent in this approach will allow opportunities to revise this approach, if future trends warrant changes. Monitoring programs and other management (e.g., increased access or development of recreation opportunity) or mitigation approaches (e.g., stream improvements or hatchery supplementation efforts) must, of themselves, be carefully considered to ensure that negative effects on priority fish populations are not implemented.